From bio-based feedstocks via di-acids to multiple advanced bio-based materials with a preference for polyethylene furanoate

Berichterstattung

Projektinformationen

PEFerence

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Projektwebsite

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Periodic Reporting for period 2 - PEFerence (From bio-based feedstocks via di-acids to multiple advanced bio-based materials with a preference for polyethylene furanoate)

Berichtszeitraum: 2020-09-01 bis 2022-02-28

Zusammenfassung vom Kontext und den Gesamtzielen des Projekts

The PEFerence project will establish a globally first-of-a-kind, industrial scale (5 000 tonnes/year), cost-effective 2,5-Furandicarboxylic acid (FDCA) (diacid) biorefinery flagship plant producing bio-based chemicals for materials (such as bottles, films, Lego Bricks, polyurethanes) using also existing facilities in industrial symbiosis. The consortium aims to replace a significant part of fossil based polyesters (such as Polyethylene terephthalate (PET)), but also technologically superior packaging materials like glass and aluminum with 100 % bio-based polyesters (such as Polyethylene Furanoate (PEF)). The unique properties of PEF (excellent barrier and strength) make it a material that can be applied in areas where PET is less suitable. The initial market focus will be on applications where it can optimally leverage the superior properties of PEF. On the longer term, when FDCA is produced at large scale and technology is further matured, FDCA based polyesters are expected to penetrate further into markets which allow smaller or no price premium.

The potential significant reductions in non-renewable energy usage and greenhouse gas emissions compared to fossil based PET or aluminum based cans for PEF based packaging solutions will be assessed. Furthermore, PEF bottles can be recycled and used again as raw material for bottles, as well as in a cascading approach for packaging and textiles. During the project, fructose produced via an enzymatic isomerisation process from 2nd generation glucose will be assessed. The full value chain will be optimized ensuring cost-effective and environmentally sustainable raw material sourcing and production of FDCA, PEF and polyurethane products. Finally, together with customers and brand owners (Carlsberg, Nestle Waters, Henkel, Lego, Kebony), 100% bio-based end-products will be demonstrated and validated to ensure fast market deployment.

Arbeit, die ab Beginn des Projekts bis zum Ende des durch den Bericht erfassten Berichtszeitraums geleistet wurde, und die wichtigsten bis dahin erzielten Ergebnisse

The initial period covering the first 36 months of the project has concentrated on design of Flagship plant, first draft of Life cycle assessment (LCA), formulating PEF compounds for different end use applications, and the business & commercialization plan of YXY(R) Technology. In the plant design, the objective for the first reporting period was to start and make progress on the Basic engineering (FEED) phase. The progress made by BASF, Worley and Synvina during the reporting period is in line with the overall schedule for the FEED phase. During the first Reporting Period, the goal and scope of the LCA of FDCA and PEF polymers were set. Further, the PEF end products and their fossil-based counterparts were selected for benchmark. The first LCA results showed remarkable savings in greenhouse gas (GHG) emissions and reduced usage of fossil resources. Synvina has investigated a wide range of PEF formulations, both in-house and with partners. Different polymers & polymerisation processes have been researched, including long chain branching, lower degree of polymerization (DEG), catalyst type and recipe, impact modification, oxygen scavengers, colorants, and nucleating agents. Multiple prototypes have been developed together with converters, including small carbonated soft drink (CSD) bottles, tubes and pouches with ALPLA. FDCA and humins are being

investigated for commercial uses by Henkel and Kebony respectively.

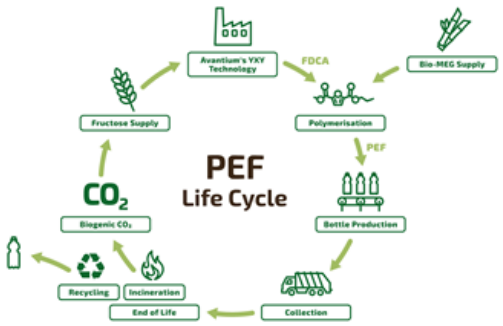
The second reporting period, has seen continued work on the plant engineering, ISO-certification of the PEF Life Cycle Assessment (LCA), continued research into the formulation of PEF compounds, and extensive testing of possible FDCA and PEF-based products. TEREOS has signed an agreement with ARNP to supply fructose feedstock to the FDCA flagship plant, and have performed the FEED for the engineering work to expand their fructose production capacity. Worley worked intensively with ARNP to finalise the FEED assessment of the FDCA flagship plant, to draft the EPC phase plan and commence the EPC phase. PEFerence partners ALPLA, Nestle, LEGO, Henkel, OMV, Kebony and new partner Carlsberg performed extensive work on the development and testing of prototype bio-based products, with very promising results in many cases. A summary of the ISO-certified LCA of PEF has been published, sharing with the public the greenhouse gas emissions (GHG) savings that are possible with the use of PEF in place of fossil-based materials. ARNP has continued the work begun by Synvina on development of PEF formulations, and has been performing polymerisation trials on pilot scale. Significant progress has been made on the regulatory registration of both FDCA and PEF, as well as on recycling testing an European recycling approval of PEF together with the European PET Bottle Platform (EPBP). All progress made is in line with the overall project schedule.

Fortschritte, die über den aktuellen Stand der Technik hinausgehen und voraussichtliche potenzielle Auswirkungen (einschließlich der bis dato erzielten sozioökonomischen Auswirkungen und weiter gefassten gesellschaftlichen Auswirkungen des Projekts)

The PEFerence project will demonstrate the production of PEF and FDCA materials at 5 kton/year scale. The flagship plant has been financed by investments from multiple parties, including new shareholders, EU and national grants, and debt financing by Dutch banks. This is a key step not just for PEFerence and Avantium Renewable Polymers, but for all aspiring sustainable industry projects that require funding, since such projects do not fall within the typical risk profile for bank financing packages.
There is very strong market interest in both PEF and FDCA as materials from both project partners as well as other companies. Multiple parties have have signed Conditional Offtake Agreements to secure material from the FDCA flagship plant. Bio-based product development using PEF, FDCA and humins are on-going in the project, and many results are very promising.

The most impactful achievement for society is in bringing a new, bio-based plastic to market that has superior properties to the incumbent fossil-based alternative, and is also readily recyclable in existing facilities. Making it possible to go from multi-layer packaging solutions to monolayer due to the barrier performance of the material is also a major step for packaging, and has a strong positive impact on the recyclability of such packaging. In bringing PEF to the market, Avantium is contributing to re-balancing the carbon cycle, which is critical for packaging industries as climate change becomes worse. Making use of nature-based feedstocks, recycling and designing products for re-use wherever possible will help to support the environment, as well as contributing to the shift to circular economy.

The PEFerence project contributes directly to the EU Bioeconomy strategy by supporting the shift from dependency on fossil-fuels towards a post-petroleum society. The introduction of PEF into the market, a Bio-based polymer with superior properties to its fossil-fuel-based counterpart, ARNP is encouraging brand owners to step forward and join the transition to bio-based materials.
The project is also contributing to the EU's Circular Economy Package through the work on product light-weighting (reduce), re-use, and recycling. By building end-of-life research into the product development phase, the PEFerence consortium is supporting the EU Plastics Strategy objectives to transform the way that products are designed, and transition to more sustainable products. Innovation in recycling is also being encouraged, through looking at used material collection systems as well as working with EPBP on approval for co-recycling of PEF into rPET streams whilst the level of PEF in the market is low.



PEF Life Cycle

Rendering of the Flagship plant

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Permalink: https://cordis.europa.eu/project/id/744409/reporting/de