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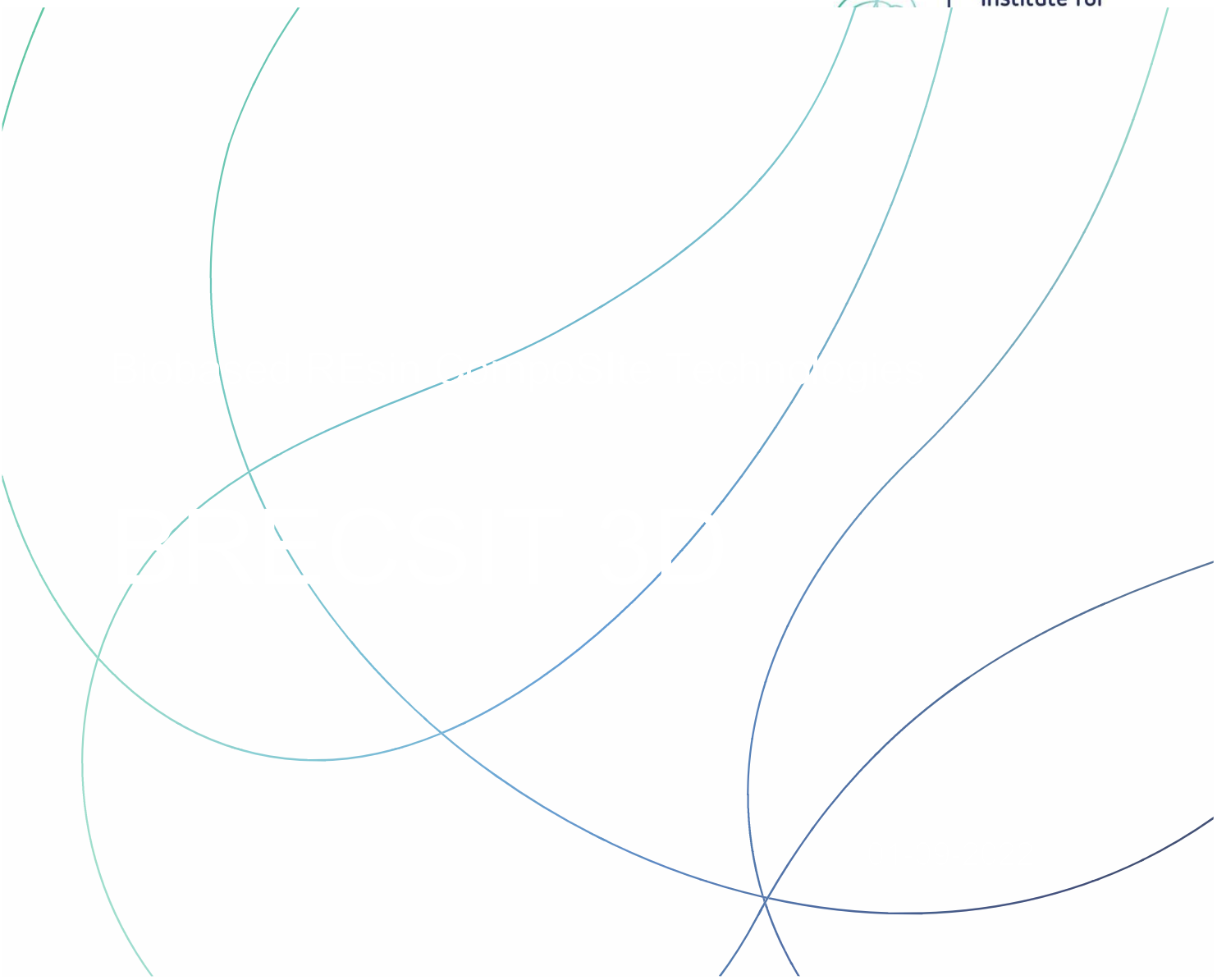

PLANTICS

TRIBOO

vepa
the furniture factory

UNIVERSITY
OF AMSTERDAM

HEMP
FLAX

Plantics

Triboo

VEPA

Universiteit van Amsterdam

Hempflax

Autonational

Institute for
Sustainable
Process Technology

Institute for Sustainable Process Technology

Public final report

Project Number RVO and/or ISPT(-TKI)	CS-20-08
Project Title + Acronym	Biobased REsin CompoSIte Technologies (BRECSIT 3D)
Secretary (penvoerder)	ISPT
Name Program Director	
Name project leader	Beer Holthuis
PhD (name & title thesis)	na
Project start	15-09-2019
Project original end date	
Project final end date	15-03-2022

Motivation
By 2015, the world had produced a cumulative 7.8 billion tonnes of fossil-based plastic — more than one tonne of plastic for every person alive today. Every year we produce almost 400 million tonnes of plastic of which roughly 20% is recycled, 25% is being burned and 55% ends up in landfills, in nature or in the ocean. Although plastics have excellent usage properties, they have devastating consequences for the environment. From the plastic soup that covers significant parts of the oceans, finding its way into a large segment of marine animals to toxic and non-degradable microscopic plastic particles that infiltrate all forms of life. Thermoset plastics, about 20% of all plastics, are a huge problem due to their toxicity, carcinogenic nature (formaldehyde), and flammability. Also, being based on fossil carbon, the production of plastics incurs large CO_2 emissions. Consequently, reducing plastic waste and lowering CO_2 emissions is a top priority environmental challenge for the EU. Using Plantics unique 100% plant-based thermoset resin (Plantics-GX) to replace all thermoset resins used world-wide, CO_2 emissions would be reduced by 200 million tonnes/year, corresponding to the entire annual CO_2 emissions of The Netherlands. The use of natural fibers and fillers (> 60 wt.% in most composites) and efficient recycling will be another step change in the reduction of CO_2 emissions and (plastic) waste.

In particular, companies making three-dimensional consumer and industry products with fossil-based reinforced or composite plastics seek sustainable bio-based product options.

Goal of the project
The goal of the Brecsit 3D project was to develop three production technologies from TRL3 to TRL7 for high volume production of bio-based and recyclable Plantics-GX 3D composites replacing conventional, fossil-based plastic composites. The three technologies are: 1) 3D printing; 2) 3D filament winding and 3) 3D hot compression moulding. Currently there are no 100% bio-based thermosets available on the market. This makes Plantics-GX resins (GX-resins) unique as it presents a cost and functionality competitive alternative to plastics, along with a fully circular product bio-life cycle. The main challenges of the Brecsit 3D project were to develop reliable processes and process conditions to meet required product properties and pilot production requirements. With these new technologies, high end, high volume products can be manufactured using Plantics GX-resin in the Netherlands and Europe. This will yield major CO_2 reductions, increased product safety and reduce the amount of plastics that end up in the environment.

Activities and results
We have developed 3 different technologies: 1) 3D printing; 2) 3D filament winding and 3) 3D hot compression moulding. We have developed several products with these technologies, and we have run several pilot productions. The main developments for the technologies are:

- **3D print**: Special GX-based 3D printing material and special machinery to work with this material were developed during this project. We have selected product applications and made several 3D printed product prototypes with the GX-based 3D printing technology. We have validated a couple of these prototypes and tested them in a commercial relevant environment.
- **3D wind**: Existing filament winding machinery was adjusted and optimized to work with GX-resin. Special production processes were developed to be able to make natural fiber and glass fiber composites with GX-resin and filament winding technology. Potential product applications were selected, and product prototypes were made and validated. The process of making preconditioned fibers with GX-resin was also successfully being researched.
- **3D mould**: Preconditioned GX-based hemp mats were developed and optimized. These mats were processed with a pressing step to a product. We have set up piolet production for several different products. These products were tested for strength, brittleness, durability and flammability.
- The potential of **re-use/recycling** of all the materials made with the different technologies was researched. A good understanding has achieved on how the recycling processes should look like and studies have been done on the molecular **mechanisms of recycling and biodegradation**.

Impact and follow-up projects
Some technologies developed in this Brecsit project has resulted in several very promising follow-up projects.

- Vepa already has two products for sale made with 3D moulding technology: the hemp fine and hemp high chair.
- Plantics and Vepa are the Winner of the Global Innovation Award: “Renewable Material of the Year 2021”
- The companies Plantics, Vepa and Autonational have got an EU-react project granted to invest in a filament winding, GX-preconditioned fiber and a GX-preconditioned hemp production line.