100 % RENEWABLE HIGH-VALUE PHB-BASED COMPOSITE MATERIALS

TURNING INDUSTRIAL BY-PRODUCTS INTO ADDED-VALUE PRODUCTS

NEWSLETTER 01/2018

The ERA-NET project PHB2Market will develop 100 % renewable, high-value composite materials made of sustainable industrial by-products or biomasses using eco-efficient industrial biotechnology and chemical processes. We combine the bio-polymer polyhydroxybutyrate (PHB), cellulose nanofibers (CNF) and bio-based, multifunctional plasticizers (BMP) to create a fully biobased composite material with enhanced properties. PHB2Market composites will be an alternative to conventional petroleum-based polymers in various applications.

Outcome of Step 1: Optimisation of biotechnological processes for a cost-effective conversion of industrial by-products and biomass into added-value products

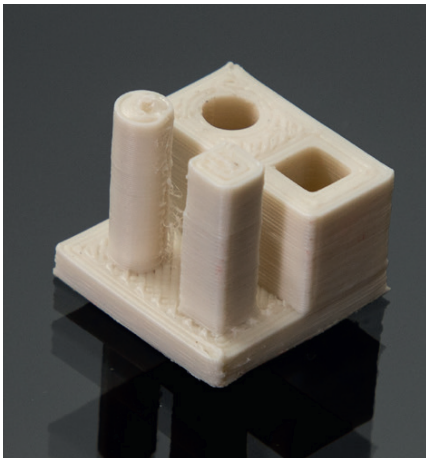
Within the first project year different grades of the **biopolymer polyhydroxybutyric acid (PHB)**, recovered from waste streams of the pulp and paper industry, have been developed and investigated. The key focus was on the influence of the processing and purification technology with respect to crystallinity properties, smell and colour. Even at this early stage the results are very promising, as tailored crystallinity properties are achieved and the product has no smell and an almost white colour.

Cellulose nanofibres (CNF) as reinforcing elements for the PHB composites were extracted from the agricultural residue hemp using a mild chemical treatment. The cellulose pulp was then subjected to an enzymatic reaction, in which the cellulose was slightly depolymerised and the number of hydrogen bonds was continuously reduced. A mechanical disintegration was applied to the water suspension of the pulp. Using this enzymatic approach, the overall energy input required for CNF production was significantly reduced.

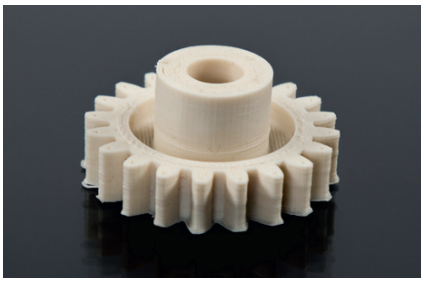
Another highlight was the development of new **bio-based multifunctional plasticisers (BMP)**, specifically designed to improve the ductility properties of PHB. The molecules of the developed plasticisers contain functional groups with a good compatibility with the PHB polymer chains, ensuring similar impact properties of the resulting materials compared to polyolefin based polymers.

Outcome of Step 2: Combination of the raw materials to create high-value bio-composite material by compounding and subsequent conversion using injection moulding and 3D-printing

In a next step, the components PHB, CNF and BMP were mixed together using a lab scale twin-screw extruder. The mechanical tests according ISO 527DIN EN ISO 527-1 (tensile test) and ISO 179-1/1eA (Charpy impact test) proved that the use of PHB2Market PHB-grades leads to **technically valuable mechanical properties** of the injection moulded samples. Although the project is only at its halfway point, a polymer composition consisting of **100% bio-based raw materials** based on renewable resources has already been developed.



In addition, initial 3D-printing filaments have been produced on a Haake kneeder and subsequently printed into a test geometry and a gear wheel to verify the printing quality. The printed parts show a good surface quality and geometrical accuracy as can be seen in the images below.



CONTACT

Fraunhofer Institute for
Chemical Technology ICT

Kevin Moser
Joseph-von-Fraunhofer Str. 7
76327 Pfinztal (Berghausen), Germany
Phone +49 721 4640 533
kevin.moser@ict.fraunhofer.de

www.phb2market.eu

CONSORTIUM

biotrend experts in bioprocessing
ICSO
Fraunhofer ICT
IBWCh Institute of Biopolymers and Chemical Fibres
SILESIAN POLYMERS

THIS PROJECT IS SPONSORED BY THE FOLLOWING INSTITUTIONS

SPONSORED BY THE
Federal Ministry of Education and Research
The National Centre for Research and Development