Bio-based and recyclable: using cellulose as a lightweight construction material

About this project

CELLUN

Bio-based and recyclable: using cellulose as a lightweight construction material

Markets:

Material: Biocomposites, Others (Cellulose fibres, cellulose acetate propionate fibres), Thermoplastics, Yarns, rovings, Woven fabrics, Others (Hybrid yarns), Others (Cellulose fibre-reinforced plastics)

Bio-based and recyclable: using cellulose as a lightweight construction material

About this project

This project is funded by the Technology Transfer Programme Leichtbau (TTP LB) of the Federal Ministry of Economics and Energy.

Technology Transfer Program Leichtbau

Context

Fibre-reinforced plastics are key materials in lightweight construction. They combine high mechanical stability with low weight and are used in vehicle components, structural elements and housings, for example. However, the majority of these composite materials are based on fossil raw materials - in particular on petroleum-based plastic matrix systems such as epoxy resins or polyamides. The common reinforcing fibres, such as glass or carbon fibres, are also energy-intensive to produce and difficult to recycle. The recycling of these composite materials often fails because the matrix and fibres can hardly be separated from each other by type.

At the same time, bio-based materials such as those based on cellulose, the main component of plant cell walls, are gaining in importance. Individual developments show that cellulose can be suitable both as a matrix and as a fibre for the composite. However, comprehensive solutions for fully bio-based, mechanically resilient and industrially processable composite materials with a functioning recycling concept are still lacking.

Purpose

The CELLUN research project aims to develop a new type of fibre composite material based entirely on cellulose. The researchers are combining high-performance cellulose fibres with a thermoplastic cellulose derivative matrix - specifically cellulose acetate propionate (CAP). Thanks to the same material base, the fibres and matrix can be ideally matched to each other. This avoids weak points at the interface. A thermoplastic material is being developed, i.e. a material that can be moulded with relatively low energy input and offers good conditions for recycling. The aim of the project team is to create a high-performance, bio-based and recyclable material for industrial applications in lightweight construction.

CELLUN aims to close the gap between ecological sustainability and technical requirements. The material should be able to be processed in common manufacturing processes such as pultrusion, FIM or compression moulding and at the same time enable single-origin recycling - through chemical recovery of the cellulose and cellulose derivative matrix.

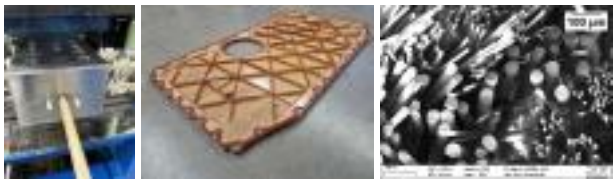
Bio-based and recyclable: using cellulose as a lightweight construction material

About this project

Procedure

Firstly, the project team develops suitable material components. To do this, the researchers select cellulose fibres, chemically modify their surface and match them specifically to the cellulose acetate propionate matrix. In the next step, the components are further processed into hybrid textiles using processes such as commingling and weaving, from which fibre composites are created using pultrusion, hot pressing or FIM. Here, particular attention is paid to the adhesion between fibre and matrix - a decisive factor for mechanical resilience.

The researchers test properties such as strength, formability, thermal stability and flow behaviour in the various manufacturing processes. At the same time, they are developing methods for recycling the material. The scientists are investigating how offcuts and discarded components can be mechanically shredded and chemically broken down into their starting materials. In pilot tests, they are producing the first demonstrators with application-orientated geometries for various industrial products.



Funding duration:

Funding sign: 03LB3011 **Funding amount:** EUR 2.3 million

Final report

Further websites

Bio-based and recyclable: using cellulose as a lightweight construction material

Project coordination

Contact:

Mr Carlo Pani

+49 49 711 9340 455

carlo.pani@ditf.de

Organisation:

German Institutes for Textile and Fibre Research Denkendorf (DITF)

Körschtalstraße 26
73770 Denkendorf
Baden-Württemberg
Germany

www.ditf.de

English (EN){{ Projektpartner }}

TLH TECHNIKUM LAUBHOLZ
CORDENKA
elringklinger
FIBER ENGINEERING
FIBER BLOWING TECHNOLOGIES
CG TEC
Innovative Faserverbund Technologie

Bio-based and recyclable: using cellulose as a lightweight construction material

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts, Materials, Tools and moulds	✓
Services & consulting Consulting, Testing and trials, Engineering, Prototyping, Validation, Technology transfer	✓
Field of technology	
Design & layout Lightweight design	✓
Functional integration	
Measuring and testing technology Component and part analysis, Visual analysis (e.g. microscopy, metallography), Materials analysis, Destructive analysis	✓
Modelling and simulation Life-cycle analysis	✓
Plant construction & automation	
Recycling technologies Material separation, Recycling	✓

Bio-based and recyclable: using cellulose as a lightweight construction material

Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology Pre-preg processing, Vacuum infusion, Others (Pultrusion)	✓
Forming Thermal converting	✓
Joining	
Material property alteration	
Primary forming Pultrusion	✓
Processing and separating	
Textile technology Fibre manufacturing, Yarn & roving production, Weaving	✓

Bio-based and recyclable: using cellulose as a lightweight construction material

Lightweighting classification

	Realisation
Material	
Biogenic materials Biocomposites	✓
Cellular materials (foam materials)	
Composites Others (Cellulose fibre-reinforced plastics)	✓
Fibres Others (Cellulose fibres, cellulose acetate propionate fibres)	✓
Functional materials	
Metals	
Plastics Thermoplastics	✓
Structural ceramics	
(Technical) textiles Yarns, rovings, Woven fabrics, Others (Hybrid yarns)	✓