Hybrid lightweight construction: Digital tools optimise production and recycling

About this project

DigiPRO2Green

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Markets: 

Material: Glass fibres, Thermoplastics, Woven fabrics, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP)

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

Hybrid components made from plastic and metal save weight and combine functions. This is why they are used particularly in the mobility sector. Today, hybrid construction is often still limited to individual components, but in future structural components are set to be designed as hybrids to a greater extent throughout their entire lifecycle. At the same time, it is difficult to return these composites to the material cycle at the end of their lifecycle.

In practice, several factors complicate the recycling process: composite materials are often only recovered in small, component-specific quantities. Furthermore, recycled materials are not always available in consistent quality, and their properties vary from batch to batch. Processing them is also challenging. Added to this are limited availability and, at present, often higher costs, particularly for high-performance plastics.

For the benefits of recycling to be fully realised, development and manufacturing must be organised in such a way that material variations remain manageable – and the environmental benefits are not lost due to additional energy requirements, scrap or lengthy production start-ups.

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Purpose

The researchers at DigiPro2Green are developing and testing digital methods to ensure that hybrid lightweight structures containing recycled materials can be reliably designed and manufactured with process reliability. They aim to utilise recycled materials in applications where structural requirements are high, whilst integrating environmental impacts into decision-making at an early stage. To this end, the team is focusing on robust process control that can adapt to varying material batches without compromising quality, component integration or efficiency.

In doing so, the researchers are focusing on a comprehensive assessment spanning development and production: the environmental benefits of recycled materials should not be offset by additional costs in manufacturing. The results are to be presented in such a way that they can be applied to other components and sectors within the mobility sector.

Procedure

Firstly, the project team is developing a cloud-based online tool that combines structural performance and environmental impact requirements and supports decisions on materials and design. This enables the researchers to evaluate and document different variants in a comparable manner at an early stage.

At the same time, the team is developing production support systems that link data from simulation and development with process and machine data. A digitally modelled process chain helps to narrow down process windows prior to start-up and to monitor quality and environmental impact during production via defined checkpoints and decision points, known as ‘quality gates’. Sensors positioned close to the tools provide high-resolution status data for this purpose; models use this data to generate rapid predictions, enabling parameters to be adjusted adaptively and reducing scrap.

Finally, the researchers are testing the approach on two demonstrators: a floor assembly for a battery-electric vehicle and a structural component from the rail sector.

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Funding duration:

Funding sign: 03LB3025 **Funding amount:** EUR 5.1 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3035A - DigiPRO2Green in the federal government's funding catalogue

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Project coordination

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Synergeticon GmbH, KCS Europe GmbH

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Systems and end products, Materials	✓
Services & consulting Consulting, Engineering, Validation, Simulation, Technology transfer	✓
Field of technology	
Design & layout	
Functional integration Sensor technology	✓
Measuring and testing technology Component and part analysis, System analysis, Environmental simulation, Materials analysis, Destructive analysis, Non-destructive analysis	✓
Modelling and simulation Crash behaviour, Loads & stress, Life-cycle analysis, Optimisation, Processes, Structural mechanics, Materials, Reliability validation	✓
Plant construction & automation Others (A circular economy through the use of recycled materials and digital methods)	✓
Recycling technologies Recycling	✓

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming Extrusion	✓
Processing and separating Milling	✓
Textile technology	
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP)	✓
Fibres Glass fibres	✓
Functional materials	
Metals	
Plastics Thermoplastics	✓
Structural ceramics	
(Technical) textiles Woven fabrics	✓