Producing modular, recyclable components: Lightweight structures made of composite plastic

About this project

DOM4Composites

Producing modular, recyclable components: Lightweight structures made of composite plastic

Markets:

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

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Technology Transfer Program Leichtbau

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Context

In view of increasing climate and environmental pollution as well as EU-wide climate protection initiatives and national CO# reduction targets, the need for recyclable, resource-saving lightweight construction solutions is increasing across all industries. While large structures in the mobility and energy sectors - for example in the construction of vehicles or wind turbines - have primarily used steel and aluminium to date, new material approaches are needed to meet the new requirements for sustainability and recyclability. Fibre-reinforced plastics (FRP) offer a resource-saving alternative here. However, conventional thermoset FRPs, i.e. fibre-reinforced plastics that take on a permanent and unchangeable shape after hardening, are difficult to recycle and make repairs and dismantling more difficult. Thermoplastic fibre-reinforced composites, which can be melted and welded, offer a solution that enables greater recyclability and more flexible use.

Purpose

The central aim of the DOM4Composites project is to develop large, modular structures made of thermoplastic FRP for the mobility and energy sectors. The innovative lightweight structures are to be used in ships, rail and commercial vehicles and wind turbines, for example. The scientists want to set technological standards for more environmentally friendly production of large structures.

The researchers are already considering a disassembly-optimised design at the design stage in order to be able to recycle the materials better and increase material and energy efficiency. Thanks to the modular design, they also want to simplify the repair of individual modules, which can increase the service life of entire assemblies. Thanks to the innovative design, materials could be reused several times, the weight of the structures could be significantly reduced and CO# could be saved during production and utilisation.

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Procedure

The team develops scalable manufacturing processes for thermoplastic FRP. They use innovative joining and disassembly concepts to enable modular construction and subsequent recycling of the components. To this end, the researchers first define comprehensive requirements for mechanical and thermal loads as well as quality criteria for the materials for various applications.

A particular focus of the scientists is on the development of recurring substructures that allow the efficient and economical realisation of modular lightweight structures. To this end, they adapt the materials for their suitability in comprehensive material tests. To join the components, the team uses various joining techniques such as adhesive bonding, resistance welding and hybrid joining to ensure recyclability and ease of repair.

The project partners are testing the approaches developed on two cross-sector prototypes, a ship's hatch cover and the side wall of a railway vehicle body. With an accompanying life cycle analysis, the team is evaluating the ecological impact of the entire process chain in order to further optimise the environmental balance and demonstrate the potential of sustainable lightweight structures in practice.

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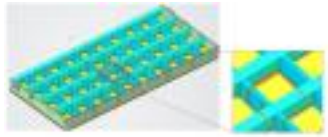

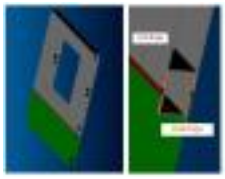

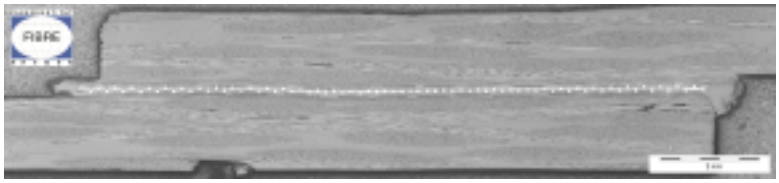

Funding duration:

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Final report

Further websites

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Project coordination

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English (EN){{ Projektpartner }}

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts, Materials	✓
Services & consulting Testing and trials, Engineering, Validation, Technology transfer, Maintenance and repair, Approval	✓
Field of technology	
Design & layout Lightweight manufacturing, Hybrid structures, Lightweight construction concepts	✓
Functional integration Material functionalisation	✓
Measuring and testing technology Component and part analysis, Environmental simulation, Destructive analysis	✓
Modelling and simulation Loads & stress, Processes, Structural mechanics, Materials	✓
Plant construction & automation	
Recycling technologies Material separation, Recycling	✓

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing Others (Vacuum infusion process, pultrusion process, injection moulding)	✓
Coating (surface engineering)	
Fibre composite technology Resin infusion process, Vacuum infusion, Others (ultrusion, injection moulding)	✓
Forming	
Joining Hybrid joining, Adhesive bonding, Welding	✓
Material property alteration	
Primary forming Pultrusion, Injection moulding	✓
Processing and separating Others (Debonding on Demand)	✓
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP)	✓
Fibres Glass fibres, Carbon fibres	✓
Functional materials	
Metals Aluminium, Steel	✓
Plastics Thermoplastics	✓
Structural ceramics	
(Technical) textiles Laid webs, Woven fabrics	✓