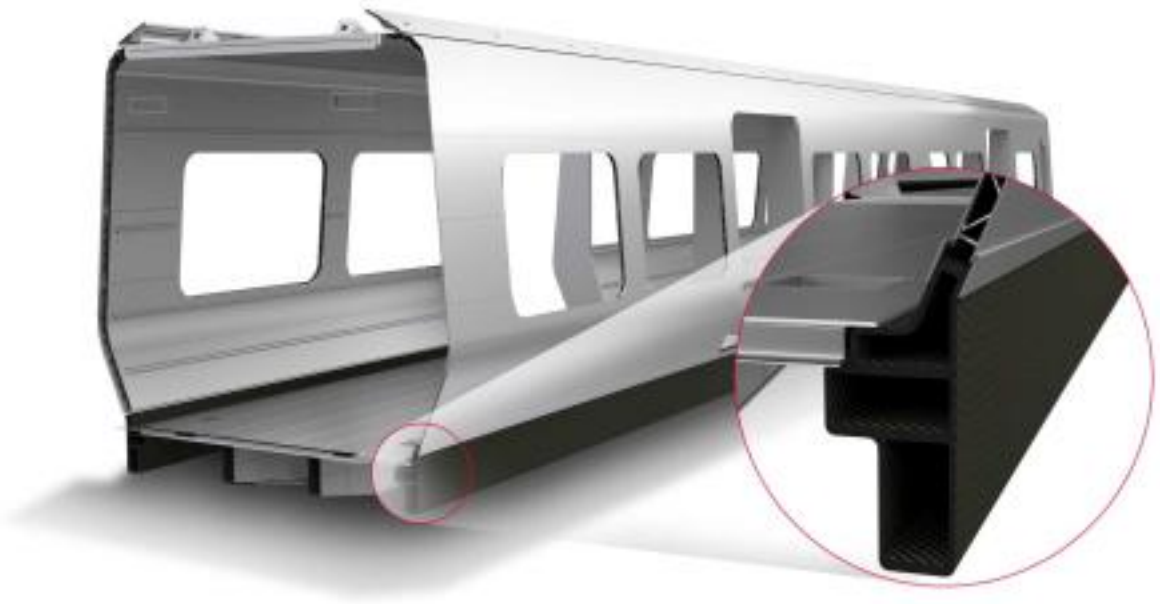
Pultrusion for fibre composites: producing multifunctional lightweight structures

About this project



FunPul

Pultrusion for fibre composites: producing multifunctional lightweight structures

Markets:

Material: Other composites, Metal fibres, Other fibres

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Technology Transfer Program Leichtbau

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Context

The demands on lightweight structures are increasing: they need to be even lighter, more economical to manufacture and take on additional functions. Fibre composites are ideally suited for this. On the one hand, their mechanical properties open up many fields of application. On the other hand, additional functions can be integrated into these lightweight elements. Just a few lightweight components can fulfil so many technical functions. However, such complex and customised structures cannot currently be manufactured economically in series production, but are instead produced in time-consuming manual work.

Purpose

The project partners are developing a process to produce multifunctional lightweight structures economically - across all sectors. To do this, they want to use the established technology of pultrusion for fibre composites. Pultrusion means extrusion. This allows continuous fibre-reinforced plastics to be produced efficiently and cost-effectively.

The project team now wants to further develop pultrusion in such a way that both additional materials and electronic components can be integrated into the lightweight structures. The scientists are pursuing two approaches: Firstly, they are developing a mechanically functionalised lightweight profile for rail vehicle construction. The lower vehicle weight can significantly reduce operating and life cycle costs in the transport sector.

Secondly, they are developing sensor-functionalised lightweight construction elements for the rotor blades of wind turbines. These sensor bridges are currently produced manually, with the embroidered strain sensors being processed in a hand laminate. The project team now wants to automate production using pultrusion and ensure mass suitability. The project team then wants to merge the two technologies and thus combine mechanical and sensory functionalisation.

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Procedure

The team integrates metal inserts into the fibre-plastic composites and creates a hybrid layered composite. The inserts act as force transmission or connection points and create additional functionalisation. The components are intended to replace the extruded aluminium profiles in the body of a rail vehicle and significantly increase the degree of lightweight construction while maintaining the same economic efficiency. After optimising the process, the researchers were able to successfully produce several demonstrators. Compared to an aluminium longitudinal beam, they were able to save around 40 percent in weight.

In a second approach, the researchers are integrating strain sensors into the pultrusion process. Their aim is to produce functionalised sensor bridges for wind turbine rotor blades. The sensors recognise overloads and damage at an early stage and have a longer service life. As a result, maintenance intervals and the utilisation period of the turbines can be extended. The team has successfully completed this development and achieved serial production.

To combine the two approaches, the project partners are producing multifunctional profiles for rail vehicle construction by integrating mechanical and sensory functional elements into the manufacturing process. This would further increase the degree of lightweight construction and the condition of the components could be monitored over their entire service life, which would further increase economic efficiency.

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Funding duration:

Project partner:

Funding sign: 03LB1002 **Funding amount:** EUR 1.5 million

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB1002A - FunPul in the federal funding catalogue

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Project coordination

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts	✓
Services & consulting	

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Lightweighting classification

	Realisation
Field of technology	
Design & layout	
Functional integration Sensor technology	✓
Measuring and testing technology	
Modelling and simulation Crash behaviour, Life-cycle analysis, Processes, Reliability validation	✓
Plant construction & automation Handling technology	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming Pultrusion	✓
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Others	✓
Fibres Metal fibres, Others	✓
Functional materials	
Metals	
Plastics	
Structural ceramics	
(Technical) textiles	