Producing high-performance fibre composites: Inline plasma coating for glass fibres

About this project

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PlasmaPrime

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Markets: 

Material: Basalt fibres, Glass fibres, Basalt fibre-reinforced plastic, Glass-fiber reinforced plastics (GFRP)

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

Glass fibre composites (GRP) are important materials for lightweight construction. This is illustrated by annual market growth of around 5 per cent. Glass fibres are inexpensive, robust and are used across all industries. However, their full potential often remains unutilised. After all, whether a component is light, stable and durable depends on how well the fibres and plastic hold together.

With conventional manufacturing methods, each fibre bundle is given an adhesion-promoting coating in the spinning process, the so-called "sizing", a chemically complex mixture of various components. In practice, however, this only wets the individual glass filaments in places. This limits the transmission of force in the GRP, components have to be designed to be heavier and age more quickly. This slows down efficiency gains in the wind energy, automotive and transport sectors, for example.

To solve this challenge, the researchers in the PlasmaPrime project are developing a process that applies a uniform, ultra-thin, adhesion-promoting plasma coating to each individual glass filament during production. This coating significantly improves the bond between glass and plastic and opens up the possibility of designing lighter components. This results in potential savings in terms of material, energy and CO#.

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Purpose

The project team is developing a coating unit that applies an ultra-thin adhesive layer to each glass filament during glass fibre production using a plasma process. The aim is to achieve consistent quality even at high production speeds of over 1000 metres per minute and a flexible chemical design of the adhesive layer that can be adapted to different plastic systems.

The researchers are initially testing a plasma system on a laboratory and pilot plant scale and then scaling it up on an industrial spinning system to demonstrate its industrial performance. Tests of the glass fibre composites produced and a demonstrator will show the effectiveness of the process. The aim is to achieve a stable, monitored process that forms the basis for later use on an industrial scale.

Procedure

The project team is developing the coating unit step by step. Simulations and measurements are being used to analyse how the plasma expands in the coating unit and how the glass filaments pass through it. On this basis, the researchers are optimising the design and process control so that each glass filament is reliably coated.

The coating unit is then integrated into a production system and the appropriate process conditions are defined, for example for the spinning speed, the filament tension or the supply of coating materials. The project team continuously monitors the operation, processes the coated fibres into test specimens and tests their mechanical properties such as adhesion, bending strength and fatigue strength. Finally, a demonstrator is manufactured from the glass bevels produced.

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Funding duration:

Funding sign:	03LB2069	**Funding amount:**	EUR 1 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2069A - PlasmaPrime in the federal funding catalogue

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Project coordination

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DBF Deutsche Basalt Faser GmbH, Universität Stuttgart - Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie (IGVP)

Lightweighting classification

	Realisation
Offer	
Products Machines and plants, Materials	✓
Services & consulting Validation, Simulation	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Hybrid structures	✓
Functional integration Material functionalisation	✓
Measuring and testing technology Component and part analysis, Destructive analysis	✓
Modelling and simulation Multiphysics simulation, Optimisation, Processes	✓
Plant construction & automation Plant construction	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering) Plasma process	✓
Fibre composite technology Fibre spraying	✓
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology Fibre manufacturing	✓

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Basalt fibre-reinforced plastic, Glass-fiber reinforced plastics (GFRP)	✓
Fibres Basalt fibres, Glass fibres	✓
Functional materials	
Metals	
Plastics	
Structural ceramics	
(Technical) textiles	