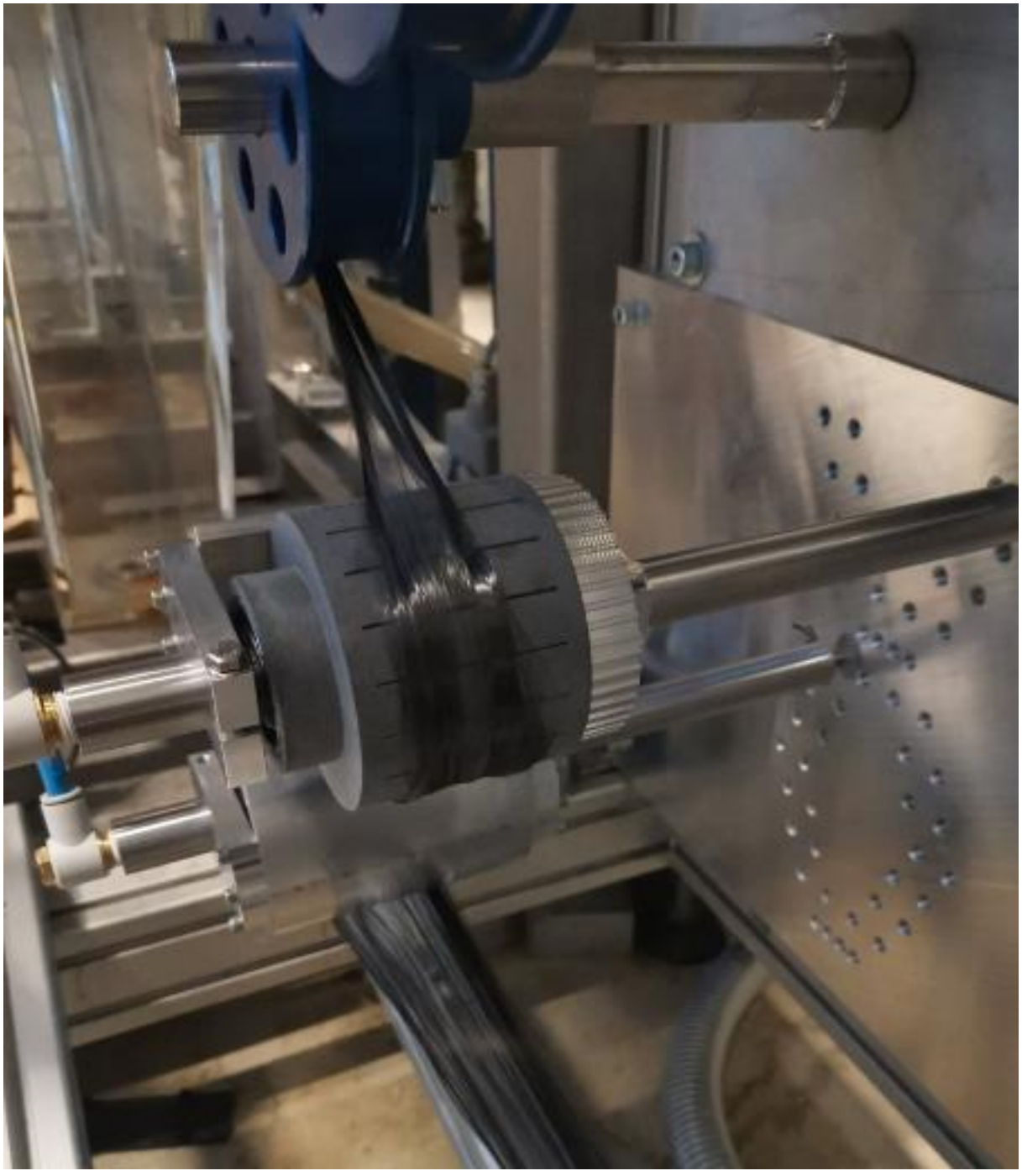
Bonding of carbon fibres to polypropylene: inexpensive, lightweight and stable components

About this project



GrafCarbon

Bonding of carbon fibres to polypropylene: inexpensive, lightweight and stable components

About this project

Bonding of carbon fibres to polypropylene: inexpensive, lightweight and stable components

Markets: 

Material: Carbon fibres, Thermoplastics, Yarns, rovings, 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

Carbon fibre composites reduce the weight of components and thus reduce energy requirements - an advantage particularly in the automotive sector. Thermoplastic composites based on polypropylene are particularly suitable for this because they can be processed quickly, are robust against impact loads and are easy to recycle. However, there is a fundamental problem with continuous fibre-reinforced structures: the carbon fibres do not bond well with polypropylene.

All bonding processes used today change the fibre surface in such a way that polar groups are formed. Polypropylene, however, has a non-polar character without such charge areas. The polar fibre surface does not match the non-polar polypropylene. As a result, the melt does not wet the fibre sufficiently and does not transfer loads reliably. The high reinforcing effect of the continuous fibre remains unused.

A technology that permanently adapts the fibre surface to the non-polar character of thermoplastic matrices is still lacking. As a result, lightweight and high-performance polypropylene composites fall short of their potential. This is precisely where the GrafCarbon project comes in.

Bonding of carbon fibres to polypropylene: inexpensive, lightweight and stable components

About this project

Purpose

The project team is developing a process that provides the carbon fibre with a thin, non-polar polymer layer during production. The basis is a plasma-based grafting process in which polymer chains are firmly bonded to the fibre surface. This chemical step permanently anchors the chains so that they mix with the non-polar polypropylene, the melt can wet the fibre better and the forces are transferred to the reinforcing fibre.

The aim is to significantly increase the adhesion between the fibre and the matrix and to exploit the reinforcement potential of the continuous fibre. This results in lighter and at the same time more resilient components that incur lower material costs and offer a better carbon footprint.

Procedure

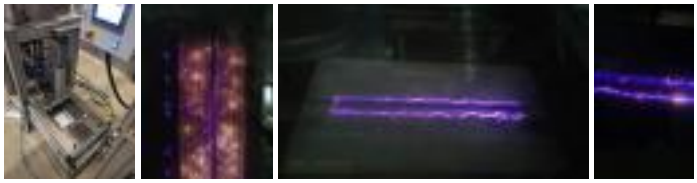
The project team is developing a plasma-based process that can be integrated directly into the functionalisation process of the carbon fibre. To do this, the researchers generate a high-energy gas that activates the fibre surface in a very short time and enables grafting. This allows the non-polar polymer chains to be stably bonded, which later enables good wetting by the polypropylene melt.

In order to achieve the best possible adhesion, the team is investigating various processes. These include varying the sequence of activation and coating, fibre guidance in the plasma and the selection of suitable polymer structures. Model tests help to optimise the reaction conditions and treat the fibres evenly.

The researchers will then transfer the process to a pilot plant and test it at real production speeds. The first mechanical parameters of the new composite are then recorded. This will provide reliable proof that the new interface customisation significantly increases the strength of thermoplastic composites.

Bonding of carbon fibres to polypropylene: inexpensive, lightweight and stable components

About this project



Funding duration:

Funding sign:	03LB2048	**Funding amount:**	EUR 1 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2048A - GrafCarbon in the federal funding catalogue

Bonding of carbon fibres to polypropylene: inexpensive, lightweight and stable components

Project coordination

Contact:

Mr Gerwin Lefers

+49 05941 604-166

gerwin.lefers@neuenhauser.de

Organisation:

Neuenhauser Maschinenbau GmbH

Elwerathstraße 9
49744 Geeste-Dalum
Lower Saxony
Germany

www.neuenhauser-ncas.de

English (EN){{ Projektpartner }}

HAWK Hochschule für angewandte Wissenschaft und Kunst - Fakultät Ingenieurwissenschaften und Gesundheit , 3 WIN Maschinenbau GmbH

Lightweighting classification

	Realisation
Offer	
Products Semi-finished parts, Machines and plants	✓
Services & consulting Consulting	✓

Bonding of carbon fibres to polypropylene: inexpensive, lightweight and stable components

Lightweighting classification

	Realisation
Field of technology	
Design & layout Hybrid structures, Lightweight material construction	✓
Functional integration Material functionalisation	✓
Measuring and testing technology Materials analysis	✓
Modelling and simulation	
Plant construction & automation Plant construction	✓
Recycling technologies Recycling	✓
Manufacturing process	
Additive manufacturing	
Coating (surface engineering) Plasma process	✓
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology Fibre manufacturing, Textile surface treatment and finishing	✓

Bonding of carbon fibres to polypropylene: inexpensive, lightweight and stable components

Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Carbon-fiber reinforced plastics (CFRP)	✓
Fibres Carbon fibres	✓
Functional materials	
Metals	
Plastics Thermoplastics	✓
Structural ceramics	
(Technical) textiles Yarns, rovings	✓