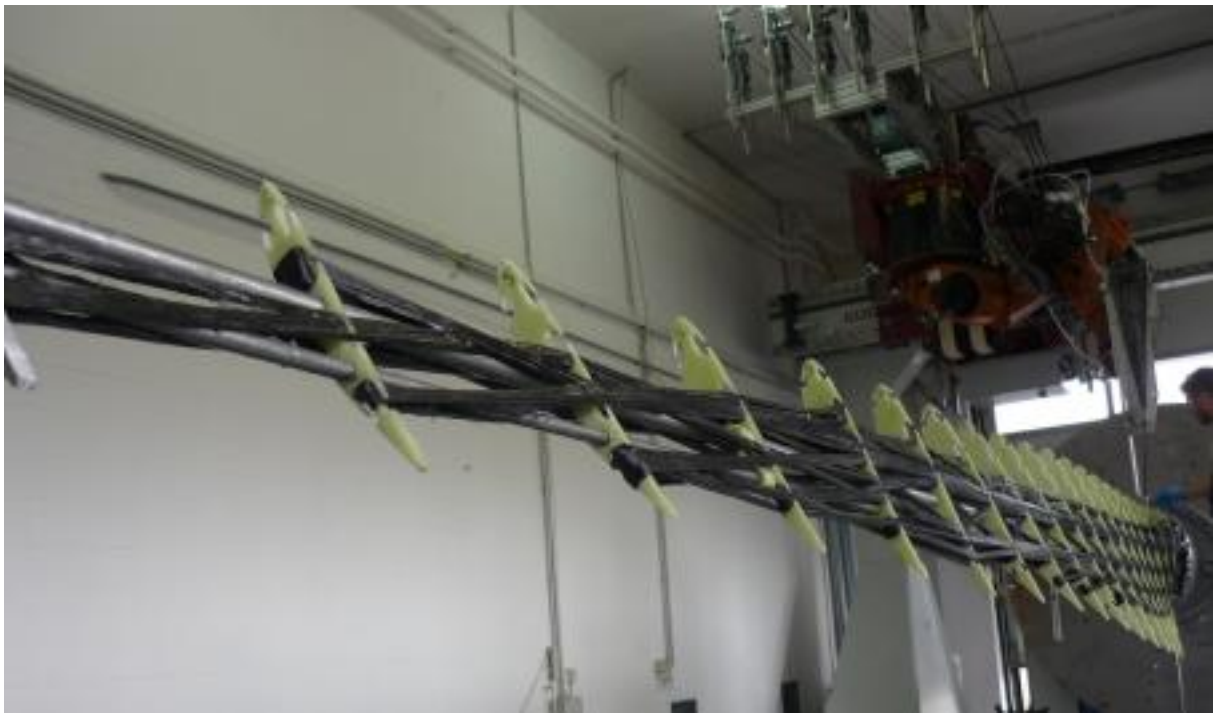
Rotor blades for wind turbines: developing a closed material cycle

About this project



GReTa

Rotor blades for wind turbines: developing a closed material cycle

Markets:

Material: Bioplastics, Others (Polyols based on renewable raw materials (Altropol)), Glass fibres, Carbon fibres, Thermoset plastics

This project is funded by the Technology Transfer Programme Leichtbau (TTP LB) of the Federal Ministry of Economics and Energy.

Technology Transfer Program Leichtbau

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Context

Wind energy plays a key role in the energy transition and the reduction of greenhouse gas emissions. At the same time, as the number and size of wind turbines increases, so does the demand for materials for rotor blades. Today, these mostly consist of complex multi-material structures with glass and carbon fibres, plastic resins and core materials such as foams or balsa wood.

After a typical service life of around 20 years, large quantities of waste are produced for which only limited recycling solutions exist to date. Rotor blades are often thermally utilised or sent to landfill. A particular problem is the strong bond between different materials, which makes it difficult to separate them by type.

Carbon fibres can be recovered by pyrolysis, i.e. the thermal decomposition of the plastic matrix in the absence of oxygen. However, the matrix components are usually utilised for energy and not recycled. As a result, valuable raw materials remain unutilised and additional emissions are generated during the production of new materials. Against this backdrop, there is a growing need for rotor blade concepts that are already designed with recyclability and closed material cycles in mind.

Purpose

The researchers in the GReTa project are developing a rotor blade concept based on the principle of "design for recycling". The aim is to create a structure based on carbon fibre-reinforced plastics that is as pure as possible and enables efficient recycling of the materials used.

The participants replace glass fibres in large parts of the structure with recycled carbon fibres. This reduces both the use of resources and greenhouse gas emissions. At the same time, they are further developing a recycling process that recovers not only the fibres but also the matrix components. The resulting pyrolysis oils are used as starting materials for new resin systems.

The researchers are using the recovered fibres and matrix materials to develop semi-finished products for automated rotor blade production. This creates a closed material cycle over the entire life cycle of the rotor blade. The approach creates a basis for resource-efficient lightweight structures in wind energy.

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Procedure

The participants first analyse existing rotor blade designs and define the requirements for a recycling-friendly structural concept. Based on this, they develop a rotor blade design with a material composition that is as pure as possible and an adapted support structure.

At the same time, they are developing semi-finished fibre products made from recycled carbon fibres and new matrix systems based on recovered pyrolysis oils. The researchers are also further developing the pyrolysis process. In future, this will allow both fibres and chemical components of the matrix to be recovered separately and reused.

The participants are also adapting production processes to the properties of the recycled materials and investigating automated manufacturing processes. They are developing several demonstrators to test their results. These include structurally relevant component areas and a complete rotor blade for a smaller wind turbine.

Laboratory tests and field tests provide data on structural behaviour, production and recyclability. The researchers then transfer the results to simulation-based analyses and evaluate the transferability of the concept to larger turbines.

Funding duration:

Funding sign:	03LB3087	**Funding amount:**	EUR 1.5 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3087A - GReTa in the federal funding catalogue

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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, Materials, Others (Propellers and rotors made of fibre composites (BaltiCo); system supplier of thermoset resin systems (Altropol))	✓
Services & consulting Training, Consulting, Technology transfer, Others (Technical application advice, specialised training and courses on processing technologies such as vacuum infusion, RIM technology, vacuum casting processes (Altropol))	✓
Field of technology	
Design & layout	
Functional integration	
Measuring and testing technology	
Modelling and simulation	
Plant construction & automation	
Recycling technologies Material separation, Recycling	✓
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials Bioplastics, Others (Polyols based on renewable raw materials (Altropol))	✓
Cellular materials (foam materials)	
Composites	
Fibres Glass fibres, Carbon fibres	✓
Functional materials	
Metals	
Plastics Thermoset plastics	✓
Structural ceramics	
(Technical) textiles	