Recycle glass fibres by type and without loss of quality: with debonding on demand

About this project

FVKCycle

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Markets:

Material: Basalt fibres, Glass fibres, Metal fibres, Thermoset plastics, Thermoplastics, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP)

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Technology Transfer Program Leichtbau

Context

Fibre-reinforced plastics (FRP) are key materials for lightweight construction - for example in the mobility, aerospace, construction and energy sectors. Glass fibre reinforced plastics (GRP) in particular currently have a large market share. However, while the advantages of composite materials in operation are convincing, the end of life of these materials poses a challenge: To date, there is no sustainable recycling strategy that allows the individual components to be separated by type and thus enables a circular material cycle.

Since 2005, FRPs have no longer been allowed to be landfilled. Instead, the components are shredded and used as low-grade fillers. Valuable raw materials such as glass fibres are lost in the process, as existing separation processes such as pyrolysis work at high temperatures - which massively damages the mechanical properties of the glass fibres. In addition to the technical challenges, a state-of-the-art industrial recycling process is also not economically attractive - primarily due to the low raw material prices for glass fibres. There is therefore a great need for an energy and cost-efficient recycling solution for GRP that preserves its value - not only from an ecological perspective, but also from an economic one. This is precisely where the team in the FVKCycle project comes in.

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Purpose

The participants want to develop a recycling technology for the pure recovery of glass fibres from GRP. The process should be economical and energy-efficient and enable glass fibre recovery without any loss of quality. The focus is on the principles of recyclability by design and debonding on demand. The material selection and the introduction of thermoresponsive substances during the GRP production process should enable the targeted and controllable loosening of the material bonds.

The thermo-activatable substances are to be activated at moderate temperatures of approx. 150 degrees Celsius, creating microcracks in the plastic. This weakens the polymer matrix locally without impairing the mechanical properties of the fibres. The advantage: The quality of the glass fibres remains unchanged and the glass fibres can be reused in new GRP components after separation from the plastic breakage. In addition, the broken plastic can continue to be used, for example as a filler. In this way, the project team aims to create a holistic solution and show that recycling is possible and marketable in the GRP sector.

Procedure

The participants are pursuing a novel approach and combining technologies from speciality chemicals production, glass fibre production, coating systems and textile technology. They are developing thermoresponsive substances that are introduced into both the plastic matrix and the sizing - the bonding layer on the glass fibre. To this end, the team is developing different encapsulation strategies for the thermoresponsive substances that are tailored to the respective application environment - aqueous sizing or solvent-free polymer matrix.

Moderate heating causes adhesion fractures at the fibre-polymer interface and cohesion fractures in the polymer matrix. This weakens the material at the crucial points and the glass fibres can be mechanically separated from the plastic without any loss of quality. The researchers will then test the process developed on a laboratory scale under realistic conditions to verify its suitability for practical use.

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English (EN){{ Projektpartner }}

Albon-Chemie Dr. Ludwig-E. Gminder GmbH & Co. KG

Lightweighting classification

	Realisation
Offer	
Products Semi-finished parts, Materials	✓
Services & consulting Testing and trials, Funding, Prototyping, Technology transfer	✓
Field of technology	
Design & layout Hybrid structures	✓
Functional integration Thermal activation, Material functionalisation	✓
Measuring and testing technology Component and part analysis, Materials analysis	✓
Modelling and simulation Materials	✓
Plant construction & automation	
Recycling technologies Recycling	✓

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology Fibre manufacturing, Yarn & roving production, Nonwoven & mats production, Knitting, laid web production	✓
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP)	✓
Fibres Basalt fibres, Glass fibres, Metal fibres	✓
Functional materials	
Metals	
Plastics Thermoset plastics, Thermoplastics	✓
Structural ceramics	
(Technical) textiles	