

Lightweight pressurised tanks for hydrogen: improving digital development and recycling

About this project



HoliCPV

Lightweight pressurised tanks for hydrogen: improving digital development and recycling

Markets: 

Material: Carbon fibres, Thermoplastics, 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](#)

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Context

Hydrogen is considered an important energy source for climate-friendly mobility. The gas is stored under high pressure in tanks for storage and transport. These pressurised tanks must be able to withstand high mechanical loads and at the same time be as light as possible. Fibre-reinforced plastics are often used for this purpose in mobile applications. Carbon fibre-reinforced plastics in particular enable major weight savings compared to metal solutions.

Until now, however, conventional pressure tanks have mostly used thermoset matrix systems. These plastics harden permanently and cannot be melted afterwards, which makes recycling more difficult. With the expected growth in hydrogen mobility, the demand for such materials is also increasing, as is the volume of composite waste.

New thermoplastic fibre composites offer advantages here, as the matrix material can generally be remelted and further processed. At the same time, these materials place additional demands on design, simulation and production. Existing software tools are predominantly designed for established manufacturing processes and only take these new materials and processes into account to a limited extent. As a result, existing potential for material savings, efficient production and recycling can only be utilised to a limited extent.

Purpose

The researchers in the HoliCPV project are pursuing the goal of creating a networked digital development environment for pressure tanks made from thermoplastic fibre-reinforced plastics. This toolchain - a linked group of digital development tools - connects central applications along the entire development chain, from design and simulation to production planning and quality assurance.

On this basis, the participants want to develop new pressure tank concepts that specifically utilise the advantages of thermoplastic materials. These include a lower component weight, reduced material consumption and better conditions for high-quality recycling. A digital twin of the pressure tank forms the basis for continuous data utilisation throughout the product life cycle. The networked development also enables a realistic mapping of production and thus improves the design and production quality of future generations of pressure tanks.

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Procedure

To begin with, the participants analyse the requirements for hydrogen pressure tanks and existing development and production processes. On this basis, they are developing a digital toolchain that links the various development and production steps.

The researchers are initially developing a tool for computer-aided design and production planning that can be used to plan winding paths for thermoplastic fibre composite tapes. At the same time, they are developing a data-based process model for tape winding that takes real process data into account and derives suitable production parameters.

Building on this, the participants are developing a simulation module for the automated mechanical design of the pressure tanks. This model uses real production data and winding paths to map the structural behaviour as realistically as possible.

The project partners link all modules with each other via a common data structure, creating a digital twin of the pressure tank. The participants then test the developed toolchain on demonstrator pressure tanks, which are manufactured and tested in an industrial environment.

Funding duration:

Funding sign:

03LB3101

Funding amount:

EUR 1.2 million

Final report

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB101A - HoliCPV in the federal funding catalogue

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Project coordination

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English (EN){ { Projektpartner } }



Lightweighting classification

Realisation

Offer

Products

Systems and end products, Materials



Services & consulting

Engineering, Simulation, Technology transfer



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Lightweighting classification	
	Realisation
Field of technology	
Design & layout Lightweight material construction	✓
<i>Functional integration</i>	
Measuring and testing technology Materials analysis	✓
Modelling and simulation Processes, Structural mechanics, Materials, Others (Winding simulation)	✓
<i>Plant construction & automation</i>	
Recycling technologies Recycling	✓
Manufacturing process	
Additive manufacturing Others (Tape wrapping)	✓
<i>Coating (surface engineering)</i>	
Fibre composite technology Filament winding	✓
<i>Forming</i>	
<i>Joining</i>	
Material property alteration Heat treatment	✓
<i>Primary forming</i>	
Processing and separating Cutting, Others (Melting)	✓
<i>Textile technology</i>	

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Lightweighting classification	
	Realisation
Material	
<i>Biogenic materials</i>	
<i>Cellular materials (foam materials)</i>	
Composites Carbon-fiber reinforced plastics (CFRP)	✓
Fibres Carbon fibres	✓
<i>Functional materials</i>	
<i>Metals</i>	
Plastics Thermoplastics	✓
<i>Structural ceramics</i>	
<i>(Technical) textiles</i>	