SUCCESS STORY

Polymers4Hydrogen
Decarbonizing of energy infrastructure using novel polymers

Program: COMET – Competence Centers for Excellent Technologies

Program linie: COMET-Modul

Subproject: Novel matrix materials and design concepts for high pressure storage vessels", 01/2020-12/2023

DEVELOPMENT OF A MANUFACTURING PROCESS FOR CONFORMABLE PRESSURE VESSELS

THE DEVELOPMENT OF A NEW MANUFACTURING CONCEPT FOR CONFORMABLE HYDROGEN TANKS OFFERS INTERESTING PERSPECTIVES FOR THE AUTOMOTIVE INDUSTRY.

Hydrogen storage in cars

As a climate-neutral energy carrier, green hydrogen offers great potential - also as a fuel for cars. To date, battery-powered electric vehicles are the predominant environmentally friendly alternative to internal-combustion engines. However, fuel-cell electric vehicles are a promising alternative for consumers, especially for long driving ranges, as they offer advantages such as short refueling times and low seasonal range reduction. A major disadvantage of hydrogen cars is their high price, which is largely due to the lower production volume. A promising way to reduce costs through economies of scale is to use common vehicle architectures for battery and fuel cell electric vehicles. In this case, a flat installation space is available in the vehicle underbody for the hydrogen storage system. Currently, in passenger cars hydrogen is typically stored as a gas at 70 MPa in cylindrical composite pressure vessels. However, cylindrical geometries vessels are only suitable to a limited extent for the flat installation space in the vehicle underbody. Cuboidal tanks conforming to the installation space offer great potential for optimum utilization of the volume and thus for achieving longer driving ranges.

Up to now, conformable hydrogen tanks have not yet been used in vehicles. While the tank wall in cylindrical and spherical tanks are mainly subjected to tensile loads, in tanks with deviating geometries high bending forces occur under internal pressure. An approach to counteract these forces is the integration of reinforcing structures inside the tank volume. This results in manufacturing challenges, especially for lightweight composite tanks. In order to address these challenges, new approaches have to be developed based on established manufacturing processes that

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are suitable for series production. For this reason, research is being carried out the Technical University of Munich on a new production concept for conformable composite tanks as part of the COMET module "Polymers4Hydrogen".

New manufacturing process

The innovative process consists of four basic steps, which is shown in Figure 1, and offers the possibility of manufacturing a composite tank with integrated tension struts using the established filament winding process. The connection of the struts to the tank wall is crucial since this is where the forces counteracting the internal pressure are introduced. Since in the developed concept the reshaped ends of the struts are anchored in different layers of the CFRP laminate, a fiber-optimized load transfer can be achieved.

Impact and effects

The manufacturing concept developed in the COMET module "Polymers4Hydrogen" enables the production of lightweight composite tanks with geometries adapted to the available installation space. This offers great potential for the use of common vehicle architectures for battery and fuel cell vehicles, leading to a cost reduction of the overall system through economies of scale.

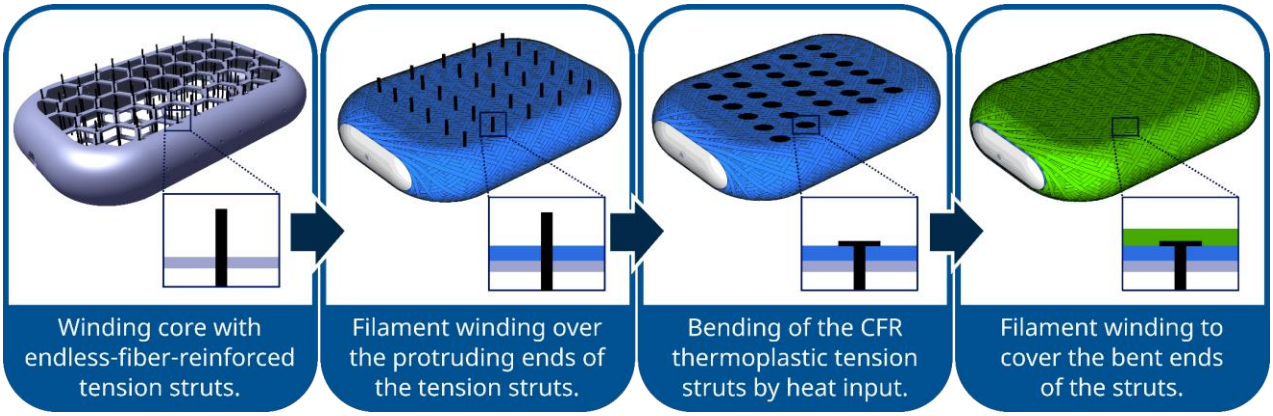

Figure 1: The main process steps to manufacture a conformable pressure vessel.

Project coordination (Story)
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