Chair of Carbon Composites
TUM School of Engineering and Design
Technical University of Munich

Bachelor's Thesis, Term Paper, Master's Thesis

Design and Development of a Novel Destructive Testing Method for Dome Regions of Type V Composite Pressure Vessels

Fiber-reinforced polymer (FRP) composites, renowned for their exceptional strength-to-weight ratio, are increasingly employed as load-bearing structural elements in both the aerospace and automotive sectors. In recent years, both industries have witnessed a growing demand for composite overwrapped pressure vessels (COPVs), driven by economic, environmental, and competitive considerations. This rising demand has not only intensified market competition but also elevated the technical and regulatory requirements associated with these components. Consequently, new challenges have emerged across the entire value chain. To address these evolving demands and to enable further innovation and optimization, a comprehensive understanding of the design, development, and manufacturing processes of COPVs is essential.

This research introduces a targeted testing methodology for the dome regions of COPVs, aiming to address a critical gap in current structural validation practices. In contrast to conventional burst pressure tests, which are costly and non-specific, the proposed method is intended to enable localized mechanical assessment of geometrically complex areas, without the need for full-scale prototypes or extensive infrastructure. To implement this, a test rig for the half-spherical dome areas, compatible with the current tank geometries used at the chair, will first be designed and manufactured. In a second step, the rig will be interfaced with the existing UTMs at the LCC, to verify the design. For this purpose, tank geometries with a predefined layup will be produced, with particular focus on the layup in the dome area. Testing these structures afterwards will provide a verification of the designed test procedure and a more detailed view to the strength in the dome areas.

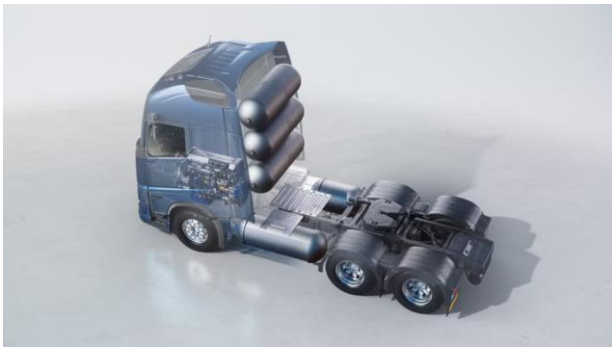

Figure 1: Volvo hydrogen concept truck [volvotrucks.de]

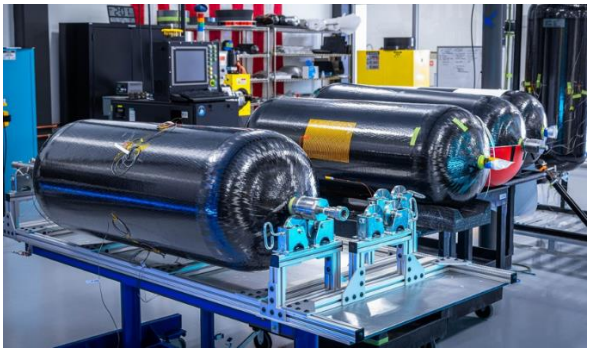

Figure 2: COPVs for spacecrafts [dawnaerospace.com]

Research focus of the thesis

- Design of a test rig for dome regions in terms of manufacturability and stability
- Manufacturing of wound structures for testing, based on current designs
- Verification of the test rig based on current data
- Development of a testing methodology for dome regions

Requirements

- Reliable, analytic and independent way of working
- Good knowledge of technical mathematics, mechanics, machine elements and composites
- Experience in programming and data processing is beneficial (e.g. Python, Matlab)
- Knowledge of winding processes and testing of composites is beneficial
- Practical experience in student initiatives is preferred

Starting date: As soon as possible

For more details please contact:
Kevin Banea, Room 5504.01.434, Fakultätsgebäude MW, Tel. +49 89 / 289 - 15128, kevin.banea@tum.de