

Structural integrity under extreme loads

Topic: Advanced Modelling of Composite Structures

TITLE: Approaches to the Modelling of the Dome of Composite Pressure Vessels

RESEARCH BACKGROUND:

H₂ is becoming increasingly appealing as an energy carrier for heavy-weight fuel-cell electric vehicles (FCEV). Due to the low volumetric energy density of H₂, its use in FCEVs is possible only when stored at extremely high pressures (350 bar and 700 bar). Composite pressure vessels are the natural choice for a light-weight, high strength design.

Aim of the theses is the building of high-fidelity models (FEM) of the dome area, the most complex of the structure, for use in impact and burst pressure simulations.

RESEARCH ACTIVITIES:

1. Acquisition of fundamental COPV knowledge and the filament wound structures.
2. Literature investigation into the existing modelling approaches for the dome regions of COPVs.
3. Implementation of those most adequate for impact damage prediction, and validation against the existing literature.
4. Impact tests on COPV domes and final validation of FE models.

METHODOLOGY: Numerical, Analytical – Experimental

DURATION: 9 months

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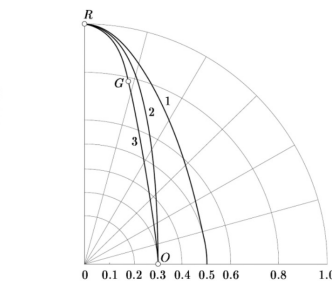
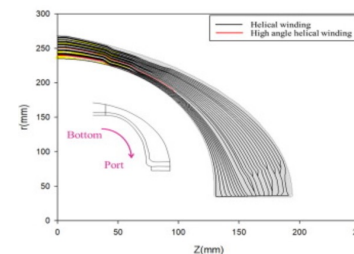
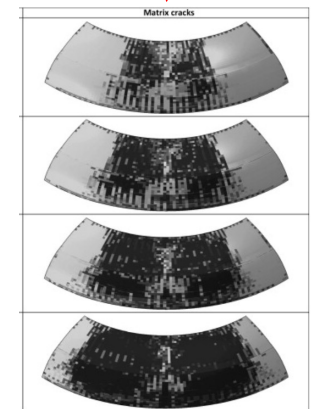
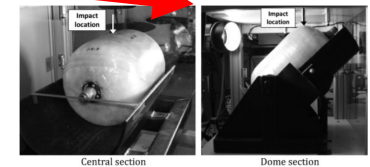
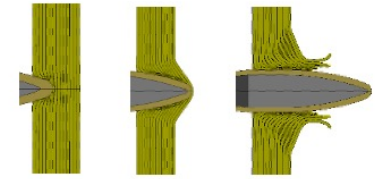
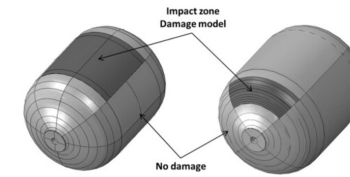
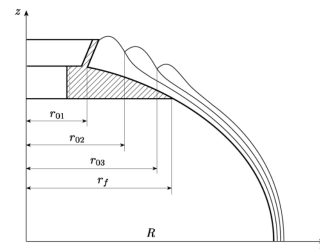


Figure 5.86 Winding Patterns for the Dome with $e_R = \sin \varphi_R = 0.5$
1 - Geodesic Winding ($k = 0$)
2 - Quasi-Geodesic Winding ($k = -0.2$)
3 - Combined Winding ($k = -0.4$ and $k = 0$)