THE INFLUENCE OF THE INTERNAL PRESSURE ON THE IMPACT BEHAVIOR OF COMPOSITE-OVERWRAPPED PRESSURE VESSELS

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Composite-overwrapped pressure vessels are typically used to store gases such as hydrogen under high pressure. Internal damage due to an impact may reduce the strength of the vessel, which means that the internal pressure at which the vessel fails, the so-called burst pressure, is significantly lower. The mechanical response and the initiated damage in the case of an unpressurized vessel have been studied in literature [1,2].

In order to improve the understanding of the impact behavior of composite-overwrapped pressure vessels, the influence of the internal pressure on the damage resistance is studied [3]. Pressure vessels with different internal pressures are loaded quasi-statically using an indenter. The damage is evaluated by use of computed tomography scans and subsequently the residual burst pressure is determined. This procedure is illustrated in Figure 1.

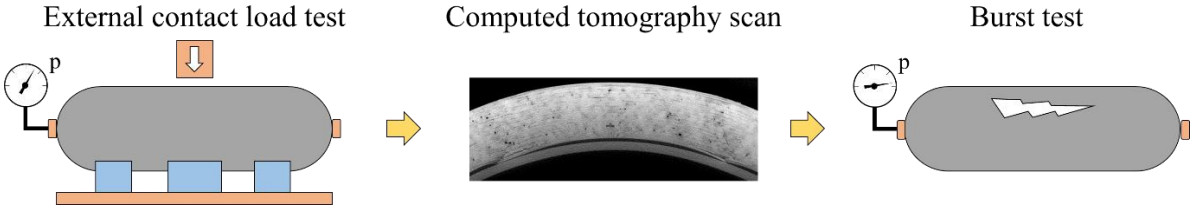

Figure 1: The experimental procedure: A pressurized vessel is subjected to an external contact load, the initiated damage is visualized using a CT-scan thereafter and is finally quantified using a burst test [3].

The damage resistance is shown to increase as the internal pressure does: The maximum force reached during contact loading increases for increasing internal pressure and the visible damage in the CT-scans is less. Moreover, the residual burst pressure is affected less when the vessel is pressurized during contact loading for the same amount of external work being applied [3].

Since these test campaigns are time and cost intensive, a numerical model is proposed that can assist future experimental programs. The model captures the cylindrical area of the pressure vessel with diminishing level of detail away from the impactor. A novel material model is introduced, which is able to capture the most important damage mechanism observed in the experimental study. The model can predict both the mechanical response during external contact loading and the initiated damage well.

References:

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