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Projekttitel:	smartVessel - Integration of fibre-based sensors during the production of hydrogen tanks for intelligent condition monitoring and prediction of remaining service life
Partner:	F.A. Kümpers GmbH & Co. KG, SimpaTec GmbH, Wölfel Engineering GmbH + Co. KG, fibrisTerre Systems GmbH, heracle GmbH, Air Liquide R&D, ITA, Fraunhofer IPT, Volkswagen Aktiengesellschaft, Audi Aktiengesellschaft, Evonik Resource Efficiency GmbH, Energieagentur.NRW
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Hydrogen storage is a key technology for the further development of hydrogen and fuel cell technology in applications such as stationary and mobile energy supply. Conventional methods of periodic non-destructive testing (NDT), e.g. ultrasonic testing and visual inspection, have contributed to increasing the reliability and safety of hydrogen tanks. The main limitation of NDT methods is the fact that they do not ensure that no damage occurs between inspections or during operation of the tanks. In order to increase the safety of hydrogen tanks during refuelling and operation for stationary and mobile applications, the approach of structural condition monitoring and the prediction of the remaining service life is required. Condition-based maintenance based on structural health monitoring (SHM) of the tanks eliminates limitations of conventional NDT methods and increases confidence in hydrogen storage technology due to increased reliability and traceability.
The aim of the smartVessel research project is to reduce maintenance costs of composite tanks for hydrogen storage and to safely exhaust the entire service life. The approach to achieve this goal is the integration of sensors during the production process for structural condition assessment and prediction of remaining service life.
SimpaTec will lead the design of the composite tanks by means of mechanical analysis - FEM-simulation of damage and failure behaviour. **heracle** will develop a sensor technology based on fibre optic sensors for tank monitoring. **F.A. Kümpers** will develop a manufacture process to obtain carbon fibre pre-impregnated tows, tow-pregs, integrated with fibre optic sensors to be applied for the multi-filament winding process. **fibrisTerre** will further develop a distributed fibre-optic sensing solution based on the Brillouin Optical Frequency Domain Analysis (BOFDA) technology in terms of resolution and integrability. Two innovative manufacturing technologies for composite tanks are to be further developed to allow in-process sensor integration: the multi-filament winding process of **ITA** and the laser-assisted thermoplastic tape winding process of **Fraunhofer IPT**. The strain and temperature state of instrumented tanks will be monitored by means of the integrated sensors during the execution of hydraulic tests. Based on the recorded data, in combination with FEM-simulation, **Wölfel** will develop a model-based system for the structural condition assessment and prediction of the remaining service

life of the composite tanks. **Evonik** will provide the requited thermoplastic tapes to Fraunhofer IPT for the laser-assisted thermoplastic tape winding. **AirLiquide** and **VW** will assess the applicability of the monitoring technology for composite tanks to be used in hydrogen refuelling stations and in hydrogen powered trucks and passenger cars. Alongside AirLiquide and VW, **EnergieAgentur.NRW** will provide technical advice to the project. Furthermore, EnergieAgentur.NRW will support dissemination actions of project results.
The continuous, reliable condition monitoring is expected to increase consumer confidence in hydrogen-powered vehicles. This in turn should facilitate the commercial adoption of the technology. In addition, the increased safety should also allow for a modification in the design of hydrogen tanks; a less conservative design will allow the current value of the burst safety factor to be reduced. This, in turn, would result in a significant reduction in materials and costs.

Kontakt

Konsortium

Aktiver Partner

Assoziierter Partner