ADHERE

Development of Advanced Composite Pressure Vessels for Hydrogen Storage

> *Advanced materials for hydrogen storage vessel using additive manufacturing and surface coating is explored, and comparing energy storage in the energy system*

Efficient hydrogen storage is crucial for the emerging hydrogen energy markets. Storage is strongly connected to the performance and safety of the components. Currently, hydrogen is stored and transported in a compressed form to satisfy safety and weight regulations for high pressure gases. Physical storage is the most mature hydrogen storage technology. The current near-term technology for on-board automotive physical hydrogen storage is in compressed gas vessels. Traditional tanks are made of stainless steel, and not suitable for on-board applications due to weight limitations. The weight is considerably lower with composite materials which also can offer high strength for safety. ADHERE aims at developing cost-competitive lightweight composite cylinders with improved mechanical and barrier properties for hydrogen storage using the additive manufacturing technology. The 3D printed surface barrier coatings make them impermeable to gases. Chemo-chromic material-based sensors will be developed and integrated into these structures for real-time monitoring of the gas diffusion. The 3D printed hydrogen storage vessels will be studied in the energy system using wind turbines.

Project Duration

15.05.2021 - 30.06.2024

Project Budget

Total Budget: € 644,967

Funding: € 635,371

Project Coordinator

CSIR - Central Institute of Mining and Fuel Research (CIMFR), India

Project Partners

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Project Website
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ERA-Net Smart Energy Systems

ERA-Net Smart Energy Systems Joint Call 2019 (MICall19)

This project has been awarded funding within the ERA-Net SES Joint Call 2019 for transnational research, development and demonstration projects. EUR 16.5 Mio of funding have been granted to 14 projects active in 15 regions and countries.

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Joint Programming for Flourishing Innovation – from Local and Regional Trials towards a Transnational Knowledge Community

www.eranet-smartenergysystems.eu

Main Objectives

The project goal is to develop cost competitive lightweight composite cylinders with improved mechanical and barrier properties for hydrogen storage using additive manufacturing technology (3D printing) and surface coating, as well as understand hydrogen storage interplay in the energy system. It also includes knowledge exchange regarding innovation capacity and impact from research.

Expected Key Results

Technology

- Demonstrate vessel for hydrogen storage using composite material with metallic surface coating
- Develop 3D printing of cylinder from polymer and carbon fiber composite with metallic inner and outer surface coating by Ni electroless deposition and Cu electrodeposition
- Apply material modelling design using CAD models and FEM modelling
- Optimise material properties and cylinder developments: size and thickness of materials, pressure, temperature bearing ability
- Prepare novel chemo-chromic material based sensors for real time monitoring of structural integrity of cylinders and hydrogen gas leakage detection
- Integration and performance analysis of hydrogen storage vessel with wind turbine

Market

- Cost reduction of hydrogen storage vessel
- Manufacturing of vessel using 3D-printing shows future market of technology knowhow
- Demonstrate flexibility of size and shape of cylinders. Allows storage vessels to be customized to fit customer's needs

Adoption

- Exchange between relevant stakeholders (technology and service providers, innovators, start-ups, end-users and communities)
- Dissemination by homepage, newsletters, social channels, direct contact and press
- Knowledge exchange workshops realized to create three-layer interaction