SUCCESS STORY

Polymers4Hydrogen
Decarbonizing of energy infrastructure using novel polymers

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Module

Single project: New experimental methods and simulation approaches to achieve a reliable prediction of the permeation of hydrogen gases through polymer composites, 01/2020-12/2023, multi-firm

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DEVELOPMENT OF A TESTING CHAMBER FOR POLYMERIC HYDROGEN (H_2) BARRIERS

A TESTING CHAMBER WAS DEVELOPED TO EVALUATE NEW POLYMERIC MATERIALS FOR EFFICIENT H_2-TANK SYSTEMS IN RESPECT OF THEIR BARRIER PROPERTIES FOR H_2 GAS.

Energy Transition empowered by Hydrogen

We cannot securely preserve our environment for the next generations without an energy transition from fossil to green energy sources. The usage of renewable energy sources, like solar or hydro power, is problematic because it is nearly impossible to time the energy production with its consumption in industry, commerce and private households.

A sustainable solution is the storage of overproduced electricity and its delivery if required. This approach could be implemented efficiently with hydrogen technology. Already, there has been successful development of concepts for storing electricity in hydrogen (electrolysis) and for using the stored energy (fuel cells). One problem which is only partly solved is efficient storage and safe transport of H_2 gas.

The Challenge of Storing Hydrogen

Often, H_2 gas is compressed at high pressure (up to 1000 bars) and stored in suitable pressure vessels and pipelines. Because of the high pressure, the pressure vessels have to be specifically designed to withstand the resulting high mechanical stress. Also, hydrogen is the smallest molecule, hence, especially at high

Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology

Federal Ministry
Republic of Austria
Digital and Economic Affairs

Version 01/2020

pressure, it diffuses through dense materials like stainless steel.

Hydrogen dissolves in the metal lattice which affects the required mechanical properties of barrier layers and reduces the lifetime of H_2 pressure vessels. Alternatively, polymers hardly interact with hydrogen chemically, are lighter and have the necessary mechanical properties like impact toughness and pliability. Unfortunately, their barrier properties are notably inferior to the properties of metals.

The objective of the module Polymers4Hydrogen is the development of suitable polymers which can be used for H_2 pressure vessels. The endeavors in the module range from the conception of new polymer matrices and the implementation of additives to enhance specific material properties to the development new measurement methods. Computer-based modelling will assist with prediction of barrier properties of polymers and facilitate future development of new materials.

Impact and effects

A new testing chamber for the evaluation of barrier properties of polymer membranes has been designed in the module. The chamber will withstand pressures up to 1000 bars and allow measurements in a temperature range from -40°C up to 85°C. New polymeric materials will be tested in this chamber to gain empirical data about their barrier properties for further optimization. Thereby, the testing chamber will make the continuous improvement of storage facilities for H_2 gas possible.

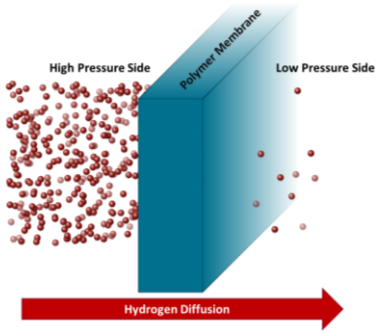

Figure 1: Schematic drawing of hydrogen diffusion through a polymer membrane.

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- Contitech Rubber Industrial Kft, HU
- SKF Sealing Solutions Austria GmbH, AT
- Bundesanstalt für Materialforschung und -prüfung, D
- Hydrogen Center Austria, AT
- Montanuniversitaet Leoben, AT

This success story was provided by the Polymer Competence Center Leoben GmbH and by the mentioned project partners for the purpose of being published on the FFG website. The project Polymers4Hydrogen is a COMET Module within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMDW and State Government of Styria. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet