ADVANCEPEM

ADVANCED HIGH PRESSURE AND COST-EFFECTIVE PEM WATER ELECTROLYSIS TECHNOLOGY

Project ID	101101318
PRR 2024	Pillar 1 – Renewable hydrogen production
Call topic	HORIZON-JTI-CLEANH2-2022-01-03: Development of low temperature water electrolysers for highly pressurised hydrogen production
Project total costs	EUR 1 631 066.56
Clean H_2 JU max. contribution	EUR 1 607 330.00
Project period	1.2.2023–31.1.2026
Coordinator	Consiglio Nazionale delle Ricerche, Italy
Beneficiaries	HSSMI Trading Limited, IRD Fuel Cells A/S, OORT Energy Ltd, Rhodia Laboratoire du Futur, Rhodia Operations, RWE Generation SE, RWE Power AG, Solvay Specialty Polymers Italy SpA

https://advancepem.eu/

PROJECT AND GENERAL OBJECTIVES

Direct production of highly pressurised hydrogen from electrolytic water splitting can allow significant amounts of energy to be saved compared with downstream gas compression. Advancepem aims to develop a set of breakthrough solutions at the materials, stack and system levels to increase hydrogen pressure and current density, while keeping the nominal energy consumption at < 50 kWh/kg H_2. Reinforced Aquivion® polymer membranes that have enhanced conductivity, a high glass transition temperature and increased crystallinity and are able to withstand high differential pressure have been developed for this application. To mitigate hydrogen permeation to the anode and related safety issues, efficient recombination catalysts are integrated in both the membrane and the anode structure. The new technology has been validated by demonstrating a high-pressure electrolyser of 50 kW nominal capacity in an industrial environment. The consortium comprises an electrolyser manufacturer, a membrane and catalyst supplier, a membrane electrode assembly developer and an end user for demonstrating the system.

NON-QUANTITATIVE OBJECTIVES

- Develop a novel polymer electrolyte membrane (PEM) electrolyser able to produce hydrogen at very high pressure thus reducing the post-compression energy consumption.
- Develop a cost-effective technology allowing to achieve large-scale application of PEM electrolysers.
- Achieve a significant reduction of capital costs by minimising critical raw materials, developing cheap coated bipolar plates and operating the electrolyser at a high production rate while assuring high efficiency and safe operation.

PROGRESS AND MAIN ACHIEVEMENTS

Functional components have been developed and stack development activities have been addressed.

The plan for validation of the PEM electrolyser is in place. The most important technical, health, safety and environmental standards, technical parameters and boundary conditions have been defined with regard to the installation, commissioning and testing of newly developed technology.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?
Project's own objectives and AWP 2022	Cold start ramp time	seconds	10	N/A	
	Degradation	%/1 000 h	0.25	N/A	
	Capital cost referred to input power	€/kW	500	N/A	
	Current density	A/cm²	5	N/A	
	Hot idle ramp time	seconds	1	N/A	
	Capital cost referred to capacity	€/(kg/day)	1 000	N/A	
	Low electrode overpotentials	mV	200	120	✓
	Electricity consumption @ nominal capacity	kWh/kg	50	N/A	
	Hydrogen output pressure	bar	200	N/A	
	Membrane conductivity	mS/cm	200	> 200	✓
	Use of critical raw materials as catalysts	mg/W	43	N/A	
	O&M cost	€/(kg/day)/year	30	N/A	
	Stack operating temperature	°C	80–90	N/A	
	Cell performance	V @ 5 A/cm²	1.85	1.83	✓

Clean Hydrogen Partnership
Co-funded by the European Union