HYPRAEL

ADVANCED ALKALINE ELECTROLYSIS TECHNOLOGY FOR PRESSURISED H2 PRODUCTION WITH POTENTIAL FOR NEAR-ZERO ENERGY LOSS

Project ID	101101452
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 3 134 235.00
Clean H_2 JU max. contribution	EUR 2 653 915.00
Project period	1.3.2023–28.2.2026
Coordinator	Fundación para el Desarrollo de las Nuevas Tecnologías del Hidrógeno en Aragón, Spain
Beneficiaries	Agfa-Gevaert NV, Fraunhofer Gesellschaft zur Förderung der angewandten Forschung EV, Green Hydrogen Systems A/S, Rhodia Laboratoire du Futur, Rhodia Operations, Solvay Specialty Polymers Italy SpA, Veco BV

http://hyprael.eu/

PROJECT AND GENERAL OBJECTIVES

Hypraelʼs goal is to develop and validate the next generation of alkaline electrolysis for highly pressurised H_2 production (at least 80 bar and preferably 100 bar). In addition, an immense increase in energy efficiency will be made possible by raising the temperature to at least 120 °C. Hypraelwill achieve these goals and move beyond the state of the art by performing research covering areas from the design and advanced assessment of electrocatalysts and polymers to the engineering and process intensification of an innovative cell design in four phases: (i) material development for pressurised electrolysis with an elevated temperature, (ii) screening of materials for applicability in pressurised electrolysers (both phases 1 and 2 will be performed at the lab scale / on a single cell with an area of 10 cm^2, 1–30 bar, 80–120 °C), (iii) scale-up of the most promising materials from phases 1 and 2 and (iv) scale-up of developed materials and their integration into an advanced stack. The validation of the components scaled up in phase 3 will be performed in the existing test bench of FHa designed in the frame of the Grid integrated multi megawatt high pressure alkaline electrolysers for energy applications (Elyntegration) project at 60 bar, 120 °C and 6–15 kW (pilot scale), whereas the demonstration at the target pressure of above 80 bar, at a minimum temperature of 120 °C and in a cell stack of at least 50 kW capacity will be developed by Green Hydrogen Systems in a new test bench. In addition, the Hypraelconcept will strongly focus on developing an energy-efficient high-pressure electrolyser while addressing the circularity principle of the objectives of the EU for a carbon-neutral economy.

PROGRESS AND MAIN ACHIEVEMENTS

In this stage of the project, the focus is to cover the development of electrodes, separators and stacks. The first year of the project is focused on the development of substrate materials (aiming to identify and produce the best structures), the selection of catalysts capable of withstanding the demanding operating conditions, and the assessment and optimisation of the coating procedures and tools. It is making progress in identifying specialty polymers and materials to act as binders and functional additives for separator design. It has produced a report on selected functional materials and combination strategies for separator preparation. The project is in the process of finalising the design of the novel pressurised stack, and assembly is under way for the stack to be tested at the pilot scale with state-of-the-art components. The activities will continue in the coming months, so conclusive results are still pending.

FUTURE STEPS AND PLANS

- Development of materials for pressurised electrolysis with an elevated temperature.
- Screening of materials for applicability in pressurised electrolysers.
- Scale-up of developed materials and their integration into an advanced stack.
- Validation in a relevant environment and at an appropriate scale.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
SRIA (2021–2027)	CAPEX	€/kW	450	
	O&M cost	€/(kg/day)/year	40	
	Cold idle ramp time	seconds	600	
	Electricity consumption @ nominal capacity	kWh/kg	48	
	Current density	A/cm^2	1	
	Hot idle ramp time	seconds	10	
	Use of critical raw materials as catalysts	mg/W	0	
	Output pressure	bar	80	
	Degradation	%/1 000 h	0.1	
Project's own objectives	Temperature	°C	120	
	LCOH	€/kg	≤ 3	