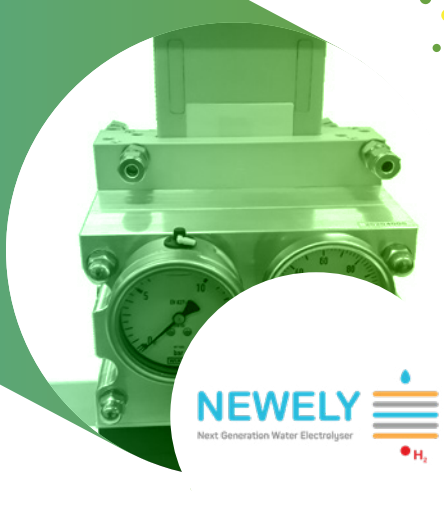
NEWELY

NEXTGENERATIONALKALINEMEMBRANEWATER ELECTROLYSERSWITHIMPROVEDCOMPONENTS AND MATERIALS



Project ID:	875118
PRD 2023:	Panel 1 – H2 production
Call topic:	FCH-02-4-2019: New anion exchange membrane electrolysers
Project total costs:	EUR 2 892 889.25
Clean H_2 JU max. contribution:	EUR 2 204 846.25
Project period:	1.1.2020–31.12.2022
Coordinator:	Deutsches Zentrum für Luft- und Raumfahrt eV, Germany
Beneficiaries:	Air Liquide Forschung und Entwicklung GmbH, Commissariat á l'énergie atomique et aux énergies alternatives, Cutting-Edge Nanomaterials (CENmat) UG Haftungsbeschrankt, DLR-Institut Für Vernetzte Energiesysteme EV, Fondazione Bruno Kessler, Korea Institute of Science and Technology, Air Liquide SA, Membrasenz SARL, Propuls GmbH, Ústav Makromolekulární chemie AV ČR v. v. i., Vysoká škola chemicko-technologická v Praze, Westfälische Hochschule Gelsenkirchen

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PROJECT AND OBJECTIVES

This project aims to redefine anion-exchange membrane water electrolysis (AEMWE), surpassing the current state of alkaline water electrolysis (WE) and bringing it one step closer to proton-exchange membrane WE in terms of efficiency, but at a lower cost. The three main challenges of AEMWE – membrane, catalyst and stack – are addressed by three small and medium-sized enterprises and a large hydrogen company supported by seven renowned research and development centres. With a prototypic five-cell stack at elevated pressure in a 2 000-hour endurance test, the performance of the state of the art (SoA) of AEMWE will be validated twice. This will have an impact on the cost of green hydrogen.

NON-QUANTITATIVE OBJECTIVES

The techno-economic assessment and life cycle assessment are expected to demonstrate a reduction of capital expenditure and operating expenses for AEMWE relative to proton-exchange membrane WE and alkaline WE. Data collection and evaluation are complete and under review.

PROGRESS AND MAIN ACHIEVEMENTS

- The membrane electrode assembly (MEA) with OXYGN-N anode, H2GEN-M cathode (both catalysts from project partner CENmat) and commercial anion-exchange membrane (AEM)/ionomer achieves 2 V at 2 A/cm^2 in 0.1 M KOH. No irreversible degradation was seen in a 400-hour test.
- AEM conductivity of 62 mS/cm and area-specific resistance of 0.065 ohm.cm^2 were achieved.
- The project created a new method for AEM membrane reinforcement with covalent bonds between the matrix and the ionomer, with conductivity of 62 mS/cm.

FUTURE STEPS AND PLANS

- MEAs for the stack will be prepared at 200 cm^2. Project materials will also be prepared, and targeted performance set. The long-term testing of the 25 cm^2 MEA is proceeding.
- Stack design will be finalised and constructed. The first draft has already been prepared and is awaiting finalisation of the configuration of components.
- The stack has not yet been put into operation at increased pressure.
- Long-term testing of the stack will seek to demonstrate the required stability. To date, testing has been up to 25 cm^2 (single cell). In-stack testing is still to be carried out.
- Data analysis for the life cycle assessment and cost analysis is at an advanced stage.

QUANTITATIVE TARGETS AND STATUS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?	SoA result achieved to date (by others)	Year of SoA target
	Maximum AEMWE stack size realised in the project						
Project's own objectives and MAWP addendum (2018–2020)	Stack power	kW	2	0.075		2.4	
	Cell area	cm^2	200	25		N/A	
	Pressure	bar (relative)	≤ 40	0	⚙	≤ 35	2021
MAWP addendum (2018–2020)	Energy consumption @ power	kWh/kg @ W/cm^2	53.6 @ 2	53.6 @ 3.6		53.6 @ 2.4	
	Corresponding to cell voltage @ current	V @ A/cm^2	2 @ 1	2 @ 1.8		2 @ 1.2	
	Non-PGM catalysts						
Project's own objectives and MAWP addendum (2018–2020)	Added overpotentials (anode and cathode)	mV	415	232	✓	250	2020
	Current density	mA/cm^2	1	1		1	
MAWP addendum (2018–2020)	Stable operation for 2 000 hours, cell voltage gap after 2 000 hours of operation	mV	50	No 2 000-hour test yet	⚙	< 2	2021
	Extrapolation to efficiency degradation at rated power and assuming 8 000 hours of operation per year	Extrapolated to %/year	Extrapolated to 7.2	No test yet		< 0.3	
	Chemically, thermally and mechanically stable AEM ionomer and membrane with conductivity	mS/cm	≥ 50	62	✓	80	
	Area-specific resistance	ohm.cm^2	≤ 0.07	0.065		0.045	

Clean Hydrogen Partnership
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