

EUROPEAN COMMISSION – FCH JU

HORIZON 2020 PROGRAMME - TOPIC H2020-FCH-02-4-2019
New Anion Exchange Membrane Electrolysers

GRANT AGREEMENT No. 875024



Anion Exchange Membrane Electrolysis for
Renewable Hydrogen Production on a Wide-Scale

ANIONE – Deliverable Report

D6.1 – Report on stack engineering and assessment
under high current density, high temperature
and pressure



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 875024. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation program, Hydrogen Europe and Hydrogen Europe Research.



Deliverable No.	ANIONE D6.1	
Related WP	WP6	
Deliverable Title	D6.1 – Report on stack engineering and assessment under high current density, high temperature and pressure.	
Deliverable Date	30-06-2023	
Deliverable Type	REPORT	
Dissemination level	Confidential – member only (CO)	
Lead Beneficiary	HYDROGENICS (Accelera by Cummins)	
Author(s)	Sebastiaan Herregods, Lisa Geerts (HYDROGENICS) Nicola Briguglio, Giuseppe Monforte, Stefano Trocino, Angela Salanitro, Mariarosa Pascale, Giuseppe Satira, Sabrina Zignani, Antonino Aricò (CNR-ITAE)	27-06-2023
Checked by	Sebastiaan Herregods (HYDROGENICS)	14-08-2023
Reviewed by (if applicable)	Antonino Aricò (CNR-ITAE)	15-08-2023
Approved by	Antonino Aricò (CNR-ITAE)	15-08-2023
Status	Final	15-08-2023

Disclaimer/ Acknowledgment



Copyright ©, all rights reserved. This document or any part thereof may not be made public or disclosed, copied or otherwise reproduced or used in any form or by any means, without prior permission in writing from the ANIONE Consortium. Neither the ANIONE Consortium nor any of its members, their officers, employees or agents shall be liable or responsible, in negligence or

otherwise, for any loss, damage or expense whatever sustained by any person as a result of the use, in any manner or form, of any knowledge, information or data contained in this document, or due to any inaccuracy, omission or error therein contained.

All Intellectual Property Rights, know-how and information provided by and/or arising from this document, such as designs, documentation, as well as preparatory material in that regard, is and shall remain the exclusive property of the ANIONE Consortium and any of its members or its licensors. Nothing contained in this document shall give, or shall be construed as giving, any right, title, ownership, interest, license or any other right in or to any IP, know-how and information.

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 875024. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation program, Hydrogen Europe and Hydrogen Europe Research. The information and views set out in this publication does not necessarily reflect the official opinion of the European Commission. Neither the European Union institutions and bodies nor any person acting on their behalf, may be held responsible for the use which may be made of the information contained therein.

Publishable summary

After appropriate screening of active materials in single cells in previous work packages, these components are validated in an AEM electrolysis stack of 2 kW capacity. An AEM stack prototype is designed for high pressure (> 30 bar) and high current density (1 A cm^{-2}) operation using an advanced design based on a proprietary compression approach and enhanced cell sealing. A flow-field free design was selected to avoid machining costs, enabling the use of cheap Ni current collectors.

In D6.1, the AEM stack prototype with 10 cells of 100 cm^2 was assembled and screened for efficiency using electrochemical diagnostics. Different orientations of the stack, temperatures, KOH circulation rates and KOH concentrations were compared. The best result, at ambient pressure, was 21 V for the stack (i.e. 2.1 V/cell) at 1 A cm^{-2} (100 A) at $50 \text{ }^\circ\text{C}$ with a recirculation rate of 1.25 ml/min/cm^2 active area and a concentration of 1 M KOH. The voltage efficiency under such conditions is about 71% vs. HHV. The H_2 flow (scaled to normal conditions) was $0.398 \pm 0.005 \text{ Nm}^3/\text{h}$ at the maximum operating current corresponding to about 97 % faradaic efficiency. The energy efficiency is thus 69% vs HHV and an energy consumption of about 57 kWh/kg H_2 at the stack level.

The stack was affected by ohmic constraints that are possibly associated to the MEAs assembling or possibly to membrane wrinkling. For further development, the origin of the contact and ohmic resistances of the stack need to be investigated. The compression torque, rigidity of current collectors, the catalyst/membrane interface and membrane swelling and resulting ease of handling will be key parameters for optimal performance.