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New Anion Exchange Membrane Electrolysers

GRANT AGREEMENT No. 875024

ANIONE

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.

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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 °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 $\pm$ 0.0.05 Nm^3/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.