5kWe AEM Stack design for direct seawater Electrolysis

Master Project (30 ECTS)/Semester Project (10 ECTS)

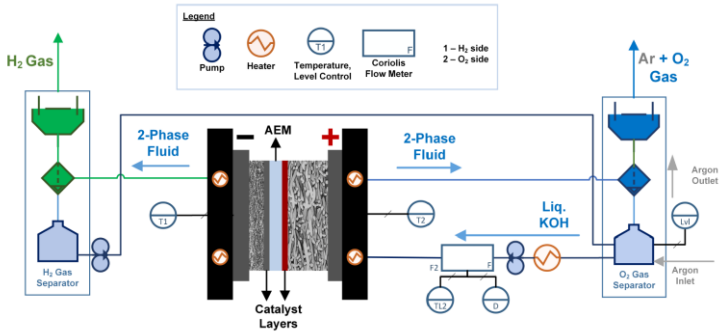
Administrative

Supervision: Simon Dorthe, Prof. J. Van Herle
Contact: simon.dorthe@epfl.ch
Location: Sion or remotely (travel allowance offered)
Remarks: If interested, please send your CV, with a short motivation letter, to Simon.
The scope and depth of the tasks may be adapted depending on whether the work is carried out as a master's or semester project.

Project description:

Direct seawater electrolysis is emerging as a promising route to produce green hydrogen at large scale, driven by growing renewable electricity deployment and the need to move away from fossil-based (grey) hydrogen. Conventional electrolysers such as alkaline (AWE), proton exchange membrane (PEMWE), anion exchange membrane (AEMWE) and solid oxide (SOEC) are typically designed for ultra-pure water or concentrated KOH solutions, which rely on freshwater and risk competing with human consumption in water-stressed regions. Seawater offers an abundant alternative feedstock but introduces challenges due to dissolved salts, organic compounds and microorganisms. AEMWE is a particularly attractive platform, combining low-cost alkaline-type catalysts (e.g. Ni-based) with membrane-based operation and higher hydrogen purity similar to PEMWE, yet it still suffers from limited lifetime and durability.

In this context, the proposed student project will focus on the design, development and, where possible, production of a 5 kWe AEM stack with 500 cm² active area per cell, capable of operating up to 80 °C and 50 bar. Particular attention will be given to stack engineering aspects such as sealing and watertightness under high pressure, selection of materials and coatings resistant to seawater-induced corrosion. The mechanical design will be optimized to provide sufficient compression to withstand operating pressures while maintaining reliable membrane–electrode contact. In parallel, the stack architecture will be refined to minimise overall volume and weight, targeting a compact, scalable design suitable for integration into industrial systems.



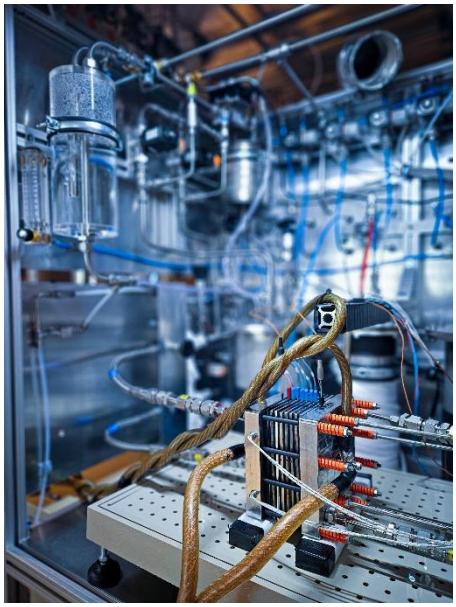


Figure 1: a) scheme of AEM stack with a simplified BoP.

b) Picture of a real experimental AEMWE stack

Your tasks:

- Conduct a literature review to understand the state of the art and main challenges in AEM stack design (if 30ECTS project).
- Analyse and learn from the existing AEM stack internally developed at GEM to identify best practices and design improvements.
- Design the manifolds and compressions system for the 5 kWe stack. Develop a concept optimized for easy/precise assembly and process efficiency.
- Develop a prototype stack section or mock-up (3d printed of other) to validate the concept and assess assembly/disassembly feasibility.
- (if time permits) Prepare drawings and specifications for parts production.