Intensification of alkaline electrolysis

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Alkaline electrolysis is typically regarded as a mature technology, since the technology has been operated on large scale for almost 100 years. However, due to the limited market for water electrolysis equipment relatively little technology development has taken place over the past decades.

Classic alkaline electrolysis is still the most competitive water electrolysis technology as evidenced by the figure, which shows two current-voltage graphs: one with the current density expressed in A/m^2 and one with the current density expressed in A/€. The latter is obtained by dividing the current density by the stack costs per m^2 (given in the left graph). These stack costs were deduced from quotations received from suppliers for a 20 MW facility in 2017-2018. From the right graph it can be concluded that the much lower stack costs of classic alkaline technology make it more attractive than PEM technology, even though it operates at a lower current density.

To make green hydrogen competitive with fossil hydrogen stack costs of <100 €/kW at an energy consumption of <4.5 kWh/Nm^3 are needed. This can potentially be achieved by increasing the current density in alkaline electrolysis by using new separators, improved electrode coatings, increased temperature and new cell designs. Promising research on all these topics has been carried out over the past decades. In this presentation a review of this research will be given and the future potential of intensified alkaline electrolysis will be discussed in light of possible GW-scale factories in 2030.

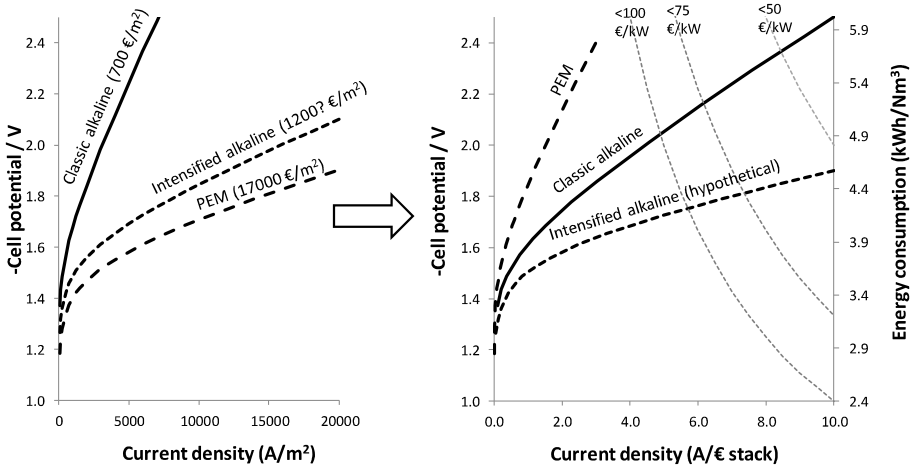

Figure: Current-Voltage curves for classic alkaline, PEM and intensified alkaline technology. The curves in the left graph were obtained from the literature [1,2] and the stack costs from quotations of alkaline and PEM suppliers. The current density in the right graph was obtained by dividing the current density (A/m^2) by the stack costs (€/m^2).

[1] H. Vandenborre, R. Leysen, H. Nackaerts, Ph. van Asbroeck, *Int. J. Hydrogen Energy,* 1984, **9**, 277-284
[2] M. Carmo, D.L. Fritz, J. Mergel, D. Stolten, *Int. J. Hydrogen Energy,* 2013, **38**, 4901-4934