REDUCING THE COST OF HYDROGEN PRODUCTION BY ELECTROLYSIS

CASE STUDY 04
BACKGROUND

ITM Power is a developer of hydrogen energy systems based on electrolysis. There are numerous applications for such systems in energy storage, clean fuel production and vehicle refuelling. This case study describes the realisation of cost reduction through advances in materials technology and system simplification. A number of important achievements have been realised, including >35% cost reduction for an existing product platform.

The objective of this TSB funded project was to reduce the production cost of polymer electrolysers to further promote the introduction of the wider hydrogen economy. A novel alkaline polymeric membrane material and processing technology were identified which eliminated the significant costs associated with conventional fluorocarbon membranes and the requirement for expensive precious metal catalysts.

This novel approach allows significant reductions in capital costs, whilst maintaining high performance (including compatibility with intermittent renewable energy sources) and extended component and system lifetimes.

“Alkaline solid polymer electrolysis offers a potentially unique way of both eliminating platinum catalysts and retaining high current density and durability; essentially getting the best out of both PEM and liquid alkaline technologies. We are very pleased with these results and have chosen to extend testing.”

Dr Graham Cooley
CEO, ITM Power Plc
PRODUCT DESCRIPTION

The key advance has been the development of a new low-cost alkaline solid polymer membrane based on ITM’s proprietary membrane technology. The new membrane, together with the low-cost catalysts, offer an electrolyser stack costing 43% of a similar stack using acidic proton exchange membranes (PEM). In addition, the properties of the new alkaline membrane enable simplification of the electrolyser balance of plant, providing routes to further cost savings.

ITM Power working in collaboration with its technology partners (Teer Coatings, University of Southampton, Boddingtons) has achieved the following improvements:

- A low-cost alkaline membrane
- A high ionic conductivity which affords high current densities and keeps electrolyser stack sizes small
- High water permeability which allows considerable simplification of the water management system so avoiding costly balance of plant whilst retaining the ability to access high current density operation
- Low-cost non-precious metal catalysts eliminating the use of expensive catalysts
- A process has been developed by ITM’s technology partners to produce corrosion resistant high surface area coatings
- Cyclic and continuous testing has accrued over 1 year’s durability data with no degradation or loss in performance

These developments offer significant potential for cost reduction across a range of ITM’s product platforms.

Materials and system simplification has reduced costs
BUILDING ON THE TECHNOLOGY DEVELOPMENTS

The successful development of the low-cost alkaline membrane electrolyser will allow ITM Power to reduce the cost of hydrogen production for products ranging from flame processing for precision welding and brazing applications to on site vehicle refuelling. For example, hydrogen and oxygen produced by electrolysis can be combusted in a brazing torch and offer advantages as an alternative to oxy-acetylene and oxy-propane:

1. The oxygen and hydrogen are generated separately, and their mixture is controlled to deliver a precise stoichiometric, oxidising or reducing flame – an innovation offering unique benefits in brazing applications.

2. The length of the flame and the heat flux imparted to the work piece can be adjusted instantaneously by adjusting the power input to the electrolyser stack – providing a more flexible and user friendly solution.

3. On site gas production eliminates the need for any stored gases, removing explosion hazards and improving process portability.

Brazing, soldering and joining processes are a fundamental requirement for industries as diverse as refrigeration, air conditioning, ship building, rail stock, car repairs, jewellery, dental technology and polishing.

The development of a new low-cost alkaline solid polymer membrane is based on ITM’s proprietary hydrocarbon membrane technology.