Fuel Cell Technology in Action

BRINGING FUEL CELLS DOWN TO EARTH IN CALIFORNIA

Southern California, which has a close association with the space programme and a continuing need to explore new and innovative approaches to improve its air quality, provided a timely venue for a recent conference entitled, "Bringing Fuel Cells Down to Earth". The conference which was organised by the South Coast Air Quality Management District (SCAQMD), and hosted and chaired by H. W. Wedaa, the Chairman of its Governing Board, was held in Long Beach from 23rd to 25th February 1994, and attracted some 200 people, including representatives from Europe and Japan.

California, and notably the Los Angeles basin, was the first area to be recognised as suffering from the deleterious effects resulting from photochemical reactions on a polluted environment and was the first to take positive steps, including legislation forcing the development of technology to overcome the problems. While it is generally recognised that much progress has been made in reducing emissions from motor vehicles, industrial sources and power generation in California, more remains to be achieved.

"The World's First Fuel Cell Powered ZEV Bus"

People attending the recent "Bringing Fuel Cells Down to Earth" conference had an opportunity to take a tour around Long Beach, California, in a zero emission vehicle powered by twenty-four of Ballard Power System's proton exchange membrane fuel cell stacks, incorporating platinum metals catalysts. This prototype bus, which is fuelled with compressed hydrogen gas and air, is intended to demonstrate that fuel cell/electric buses can provide, at least, the same performance as the corresponding diesel equivalent, while satisfying the requirements of the California Air resources Board for zero emission vehicles. Based upon a commercial thirty-two foot long bus chassis, this Phase 1 demonstration vehicle accommodates twenty seated passengers and is fitted with a wheel chair lift. Full load specifications include a range of 100 miles, acceleration from 0 to 30 mph in 20 seconds, and a top speed of 45 mph, while a 20 mph speed can be maintained on an 8 per cent gradient

For example the vehicle population and the number of miles driven continues to rise, despite restrictions on single person occupancy of motor vehicles and an expansion in public transport networks. SCAQMD estimate that there are now 9 million vehicles which travel one third of a billion miles per day in the Southern California area. It is for these reasons that "Zero Emission" technology is now being sought, not only for motor vehicles, for which legislation starts to take effect from 1998, but also for power plants, factories, offices, homes and all forms of public transport.

It is the view of the SCAQMD that fuel cell technology cannot be developed fast enough, and they therefore hosted this conference to obtain a practical and commercial overview of the subject, to review the role of government and venture capitalists in accelerating its use and to explore opportunities for job creation in a new industry.

Fuel Cells Now Operating

Progress in demonstrating the performance of PC25 units manufactured by International Fuel Cells was presented by W. Lueckel. These commercially available phosphoric acid fuel cell (PAFC) units using platinum metal catalysed anodes and cathodes are installed in a range of on-site locations in North America, Japan and Europe. Performance and durability data from the 40 units in the field is impressive with uninterrupted operation and on-line availability superior to established power generating plant including base load units. PC25 plants which will have reduced weight and volume are being developed, and will lead to a financially attractive, wholly competitive 200 kW unit with combined heat and power capabilities, by 1996.

Progress in the development of platinum metal catalysed proton exchange membrane (PEM) systems is significant, with Ballard making their PEM, hydrogen-fuelled bus shown on the previous page available for conference attendees to take a tour around Long Beach.

The development of compact PEM cells for use in transportable consumer electronic products was described by J. Maceda of H Power, in an enthusiastic presentation. His solution to the fuel challenge is to provide the user with hydrogen storage capsules that are discarded when exhausted and replaced. While this does not directly contribute to the quality of Californian air, the technical challenge presented and the potential market for these products support the overall aims.

Westinghouse, who manufacture 20 kW solid oxide fuel cell (SOFC) units, which now display significant durability, and MC Power who have plans to build two 250 kW molten carbonate fuel cell (MCFC) demonstration units in 1994/95, confirmed that progress is being made with these second generation systems.

The Government Role in Commercialising Fuel Cells

While there is already financial support from government for fuel cell R&D, several new initiatives were announced. L. Edgerton, of the California Air Resources Board, outlined how the Low Emission Vehicle (LEV) programme is expected to operate and lead to significant numbers of fuel cell powered vehicles being used in California by the year 2003. L. Paulitz, and L. Berg, from SCAQMD, described, respectively, plans for having one hundred fuel cell powered buses in operation by 1997 to 1998, and the use of emission credits to encourage the use of fuel cell powered vehicles.

So far only Californian legislation requires Zero Emission Vehicles (ZEV), and therefore, the potential market, though significant, may not be sufficient to warrant investment in manufacture by the major motor producers. However in this context, two notable developments were announced. First, a U.S. Court ruling which will allow New York and the associated twelve eastern states to adopt Californian vehicle legislation; second, SCAQMD and the province of British Columbia announced the setting up of a formal working agreement to co-ordinate their air quality management activities, including the LEV legislation.

Electric vehicles are already being produced on a limited scale by some motor manufacturers, but it is unlikely that this will result in

sufficient numbers to meet even the 1998 requirements of California. With this in mind, therefore, California believes that if the manufacture of electric vehicles is established in their state it will be a way to overcome an obvious shortcoming, and will create jobs for their declining defense industry.

Technical Advances

No significant advances in PAFC technology were disclosed at this conference, other than those concerned primarily with the systems engineering. However, significant developments were announced in PEM and direct methanol fuel cell (DMFC) technologies.

Progress in their work on PEM fuel cell materials and stacks was outlined by S. Gottesfeld, from the Los Alamos National Laboratory. A 20 kW stack with a 40 kW peak power capability for use in vehicles has been built and endurance tested for 4000 hours. Possible shortcomings in the application of this system to vehicles, such as freeze/melt cycles, have been evaluated and found not to be deleterious. Improvements to the cell and stack power outputs have been obtained using microporous gas distribution plates in preference to ribbed graphite. A 2 per cent oxygen bleed to the hydrogen fuel stream was found to be beneficial in reducing carbon monoxide poisoning effects at the anode.

Confirmation of an improved proton exchange material, which has been developed and manufactured by DuPont was also discussed. This improved polymer electrolyte, used with existing catalyst and electrode technology, enables significantly higher power densities to be achieved. J. Maceda of H Power reported that they had obtained a 100 mV improvement in cell potential using this new membrane.

If there was further development, the use of direct methanol fuel cells would provide an attractive alternative to hydrogen fuelled alkaline, phosphoric or PEM systems. However, to date power densities required for mobile applications using DMFC have not been achieved, despite extensive work in Europe and America in the last 10 years. Thus, work described by G. Halpert, Jet Propulsion Laboratory, to develop a cell system with power densities compatible with vehicle applications was therefore particularly noteworthy. Unfortunately, no details are yet available of the catalyst and electrode materials or the system that is used.

Fuel cells provide clean technology, and apart from being used in space vehicles and some special niche applications, such as "breathalyser" units, have so far promised a great deal but have not yet achieved acceptable commercial status. This conference, organised by SCAQMD with the determination to utilise innovative approaches to improve air quality, was therefore particularly timely in the ongoing development of fuel cell applications. As it is intended that this conference should become a biannual event, the next conference scheduled for 1996, with the stimulus of demonstrations of further stationary and mobile fuel cell units, will be of considerable interest not only to those who have supported fuel cell development, but more particularly to those who will directly benefit from its application. G.J.K.A.

Platinum Metals in Commercial Glassmaking

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The history of the significant contribution made by the platinum metals to the development of high quality glass is presented later in this issue. Coincidently, an English language edition of a book giving the most relevant information about the many metals used in glassmaking has just been published. One twenty-three page section is concerned with the properties of the platinum metals that establish their suitability for specific applications in the glass industry. This includes a list of guidelines indicating how to ensure the most advantageous use of the platinum metals for this purpose. The literature cited covers the period up to the late 1980s, therefore no mention is made of the benefits that can accrue from the use of innovative A.C.T.™ technology, recently made available by Johnson Matthey, see *Platinum Metals Rev.*, 1993, **37**, (1), 62–70.