



FUEL CELL TODAY

Opening doors to fuel cell commercialisation

Fuel Cell Project at Dow Chemical

Alexandra Baker, Fuel Cell Today – 13 December 2004

The Dow Chemical Company is a large producer of chemical, plastic and agricultural products and services to many international markets. In the process of building on its leadership Dow is looking to use alternative energy to make products in sustainable processes and reduce its reliance on fossil fuels. In 2002 Dow started examining different renewable energy sources for powering its major production facility at Freeport, Texas. This is one of the largest chemical plants in the world spread over 5 square miles. It is also a massive energy consumer at around 1,000 MW, equivalent to the amount of power needed for 750,000 average-sized American homes.

Hydrogen is a by-product at Dow's chemical plant in Freeport which made fuel cell power generation a viable choice. Three major hydrogen sources at Dow include the chlor-alkali process, steam methane reforming and the process of cracking ethane for plastics production. The potential benefits of 'recycling' this hydrogen through a fuel cell include a more efficient method to create electricity as well as reducing harmful emissions of greenhouse gases. It is worth noting that just at Freeport there is enough 'spare' hydrogen to generate over 100 MW of power. Currently, hydrogen is either being sold as a chemical for such activities as desulphurisation or used in gas turbines at Dow for cogeneration.

George Kehler, Dow's commercial manager for Fuels and Energy, commented: "One of Dow's options to develop a diverse portfolio to power our facilities is to produce energy off the grid through cogeneration, as well as having renewables become an increasingly more important part of the mix". This means that Dow's cogeneration activities will be changing from just burning hydrogen as a supplement to natural gas to using it more effectively and efficiently in fuel cells as well as trying to reduce Dow's reliance on the grid.

General Motors (GM) was selected as one of the potential partners for the project. One of the benefits offered is the mobility of GM's fuel cell system that is placed on a trailer giving opportunities to have power generation at different locations depending on hydrogen sources. One trailer is designed to accommodate around 10 fuel cell systems. The idea behind the partnership was to create a synergy between Dow's expertise in hydrogen production and handling and GM's knowledge of fuel cell technology. The fact that both companies are also headquartered in Michigan has speeded up the negotiation process with the mutual interest agreement signed in May 2003.

The first phase of the project was the installation of a 75 kW proton exchange membrane (PEM) fuel cell in February 2004 (see picture below) with the ultimate plan to install up to 400 fuel cells to generate over 35 megawatts of electricity at the site from 2006. GM has been operating the first fuel cell module remotely with all the performance data recorded and analysed. One of the tests was an imitation of a car's driving cycle providing valuable information about the fuel cell operation. And, of course, one of the most important factors in determining success of this project is the influence of hydrogen purity on the performance of the stack.



The first General Motors fuel cell trailer at the Dow Chemical plant in Freeport, Texas

A key issue is to identify hydrogen impurities and their impact on the fuel cell membrane performance to eliminate the most poisonous elements as it is not economically viable to remove them all. Another option is to make changes in the fuel cell itself to reduce the impact of harmful additives in hydrogen. There is a lot of joint development effort in this area between Dow and GM to determine acceptable impurities and their levels. The initial fuel cell stack, installed in February, was changed a number of times based on the test findings. Following on from these developments an additional capacity of 300 kW was installed at the end of October (pictured below) marking the start of the second phase of the project. During this stage the fuel cell pilot plant will be integrated into Dow's chemical and plastics production facility to supply up to 1 MW of energy.



Picture of the trailer currently housing four new fuel cells installed as part of Phase 2 at the Dow Chemical plant in Freeport, Texas

This development is showing encouraging results, although it is still early to confirm that this approach will be economically beneficial to use at other similar locations.