Fraunhofer Institut
Solare Energiesysteme

Press Release

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Natural Gas Reformer for Fuel Cell Application in Combined Heat and Power Plants

Fraunhofer ISE presents new work on hydrogen generation in Hanover

As part of a project focussing on fuel cells for combined heat and power (CHP) plants in residential buildings, Fraunhofer ISE has successfully taken a 2 kW_{el} fuel cell for a CHP plant into operation.

In accordance with an environmentally acceptable energy economy, fuel-cell CHP plants offer an option for decentralised of energy for buildings. Fuel cells generate heat and electricity with high efficiency from hydrogen and oxygen from the air. The hydrogen needed by the fuel cell is produced by electrolysis or reforming of fossil or biogenic fuels. Fraunhofer ISE is involved in developing hydrogen production facilities and their integration into complete systems.

The reformer for natural gas that the Freiburger researchers have developed is combined with a PEM (proton-exchange membrane) fuel cell from the "Zentrum für Sonnenenergie- und Wasserstoff-Forschung ZSW" (Centre for Solar Energy and Hydrogen Research) in Ulm. The complete system supplies 2 kW electricity and 4 kW heating power for domestic hot water and space heating. In its function as a demonstration system, it is intended to provide not only operating experience but also reliable data on the efficiency values of fuel-cell CHP plants with natural gas reformers.

Under its rated operating conditions, Fraunhofer ISE's reformer system produces a product gas which contains CO_2, water vapour and small quantities of methane and carbon

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monoxide (CO), in addition to 2 Nm^3h^{-1} hydrogen. As well as the actual steam reformer, the system includes a CO shift step for gas purification, in which the CO concentration in the reformer product gas is further reduced. Before the product gas can be converted to electricity in the PEM fuel cell of the CHP plant, the CO content must be reduced to a concentration of 50 ppm. This is done in a CO fine purification step (selective oxidation), which is developed and constructed by the project partner, ZSW. This fine purification step is necessary, because the CO would poison the noble-metal catalyst on the membranes of the PEM fuel cell in the course of time.

The reformer system is automatically controlled via a Siemens SPS to operate between 50% and 100 % of the rated load. It responds to the varying hydrogen demand of the fuel cell within minutes. The CO concentration in the product gas from the reformer system is kept reliably below 0.3 vol % (dry) at all times, even when the load changes.

The off-gas from the fuel cell, which contains unconverted hydrogen, can be used thermally in the burner of the reformer, raising the total efficiency value of the system. Not counting the combustion of the anode off-gas, the efficiency value for the reformer system is around 65 %. If the anode off-gas is burned in the burner, the reformer efficiency value can be increased to 70 - 75 %, depending on the amount of hydrogen converted by the fuel cell. "The potential for increasing the reformer efficiency is not yet fully exploited", commented Thomas Aicher, subproject leader at Fraunhofer ISE. "Better thermal integration and further optimisation of the reactor will allow us to achieve efficiency values exceeding 80 % in the near future." As the fuel cell is not yet integrated into the CHP plant, operation of the reformer system with anode off-gas is being tested with simulated anode off-gas.

The work is being carried out as part of the EDISON strategic project on "Intelligent Energy Distribution Grids by

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Natural gas reformer for a
2 kW_{el} fuel-cell CHP plant.

Application of Innovative, Dispersed Generation, Storage, Information and Communications Systems". This project is supported by the German Federal Ministry of Economics and Technology (BMWA).

Fraunhofer ISE will present its developments in the hydrogen generation sector at the Hanover Fair. These include electrolysis as well as reforming. The Norwegian Institute for Energy Technology ife has obtained a 2 kW electrolyser built by Fraunhofer ISE. It was successfully integrated into an automated complete system with photovoltaic modules, a battery, hydrogen storage unit and fuel cell. Current investigations with the demonstration system are providing information on system dynamics and optimal operation management.

Hanover Trade Fair: 7th - 12th April 2003
Fraunhofer ISE: Hall 13, G72
New prototypes of miniature fuel cells can also be seen there (see separate press release).

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