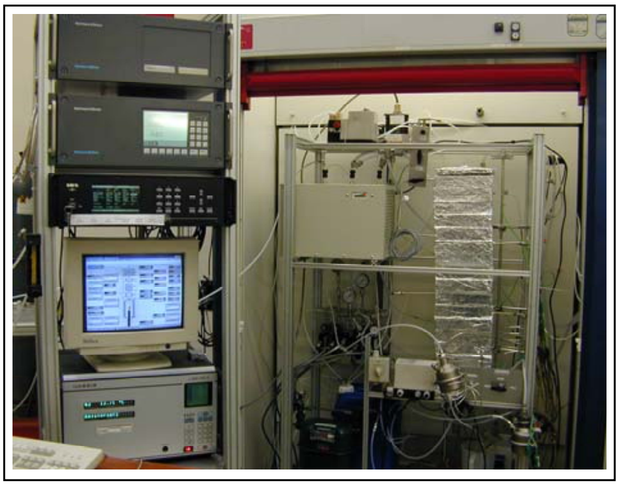
Project Information

Subject: Natural gas fuel processor for stationary PEFC application



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Description of Project:

The object of the project was to develop a cost-effective natural gas processing system for use in combined heat and power applications based on membrane fuel cells (PEFC). Respectively, the choice and the development of essential components was one main purpose of the program. In particular, the project was focused on basic investigations with respect to the hydrogen generation from natural gas, the hydrogen purification and the construction of a demonstrator which should be coupled with a PEM fuel cell. An experimental setup should show the operativeness of the fuel processing principle.

The fuel processing system should be able to work on different qualities of natural gas from the public gas supply system to allow a wide use of the technology for residential power supply. To supply a fuel cell suitable for a small CHP unit the pressure range and the requirements concerning the purity of the product gas have to be set to suitable values. For successful application low cost, high reliability and high efficiency are basic requirements.

The steam reforming of natural gas has the advantage of a high hydrogen content in the product gas and was therefore chosen for the fuel processing system. Behind a first desulphurisation step the natural gas is mixed with water and in presence of a nickel-catalyst it is converted at 800 °C mainly into CO, CO_2 and H_2. Afterwards, the carbon monoxide which acts as a catalyst poison in a PEFC is oxidised with the aid of water into carbon dioxide. This conversion takes place at so called shift conversion steps (High Temperature Shift and Low Temperature Shift) while producing an additional amount of hydrogen. Downstream the shift conversion steps the product gas contains about 1 % CO. To achieve a carbon monoxide content of less than 20 ppm a preferential oxidation step (PROX) was investigated, where the CO should react with O_2 from air in a selective manner to form CO_2. Behind that step the product gas would be suitable to be fed to a fuel cell.

Based on an analysis of the electricity and heat demand of private households the power range of the reforming system was set to 2.5 kW thermal (respective to 1 kW electric of the fuel cell). To achieve higher power levels a number of these systems could be coupled. The separate reactors have been designed based on catalyst screening methods and were tested at steady state as well as start-up, shut down and load change conditions.

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