

Pilot Project at the Airport in Munich

Still Truck with Fuel Cell in Test-Operation

The Still GmbH from Hamburg has equipped its top model fork lift truck with a fuel cell for a trial application. Partner of this trendsetting project is the Proton Motor GmbH (Starnberg), that supplies the cell itself and parts of the system and the Linde Gas for the concepts and the design of the hydrogen components. Linde Gas is a business division of the Linde AG (Wiesbaden) and Europe's leading producer of industrial gases. Still itself provides a slightly modified serial electric truck type R60 which was adapted at the mechanical and electric interfaces. The innovative truck was presented to the public for the first time in October 2003 in Hamburg and was received with great interest.

Amongst the majority of the experts, hydrogen is seen as the future energy source. Today already, there is a tough competition with Japan and the USA to develop the basics for the profit promising hydrogen technology. Therefore, the entry for this new technology must be made in due time, in order not to be left behind and to create jobs in the high-technology sector. For this reason, leading companies have founded a consortium (ARGEMUC) that is to implement the project "Hydrogen at the Airport Munich" together with the Bavarian Ministry of State for Economics, Traffic and Technology (Bayrisches Staatsministerium für Wirtschaft, Verkehr und Technologie). The start-up of this was made on July 1st 2001.

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Demonstration Project for Hydrogen Applications

The strategic project is to support demonstrate the energy application of hydrogen and to provide the floor for broad scale use. For the first time worldwide, fully automatic refuelling and the operation of ramp-vehicles (busses and cars) will be tested in combination with fleet operation under the safety requirements of an airport. The hydrogen refuelling point, which is also open to the public and the hydrogen production by a newly developed pressure electrolyser are important milestones for this future technology.

Take-up of the operation of the fork lift truck by CargoGate GmbH in multi-shift operation until the end of 2004 initiates the second phase of the project – and a new age for electric trucks. “Goal is the operation under real conditions in order to determine the technical and economic surroundings”, explains Dipl.-Ing. Reinhard Heilemann, manager of the central department Product Management at Still. For this reason, the TÜV Süd (Technical Inspection Group) was involved to evaluate the system and its applicability. This evaluation showed a positive result.

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Battery Compartment also Holds Fuel Cell System

The fuel cell-driven truck was developed following pragmatic principles: The standard battery of the R60 is replaced by a complete and equivalent system. I.e. the same energy must be provided from the available compartment which must also host the necessary components. "The requirements for the operation are set not to make a difference to the standard serial truck", explains Dipl.-Ing. Dietmar Kubusch, manager environment and work safety at Still. This means at the end that 30 kilowatt hours must be effectively available at identical performance data. Additionally, an electric energy storage will be integrated into the system to take up the braking energy of the truck and to provide the required top performance during acceleration. Altogether, the fuel cell solution offers great advantages: Now, a five-minute refuelling will replace charging of the battery (6 to 10 hours) or the changing of the battery. Further, refuelling is possible at any time independent of the filling level of the tank. The difference between the light-weight fuel cell system and the heavy lead-batteries is compensated by additional weights in order to keep the load capacity of the truck.

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The hydrogen is stored in two tanks each with a capacity of 39 litres, corresponding to a volume up to 2,0 kilograms. The basis is a pressure container made of fibre with an aluminium core making it more cost-efficient than a liquid gas or metal hydride storage. According to the state of the art, the system is designed for a pressure of 350 bar; tanks for 700 bar are already being developed. The selected fuel cell is a PEM type and thus is fitted with an Proton Exchange Membrane. Altogether, the installation consists of 3 modules, each providing a permanent power of 6 kilowatts. The oxygen required for the reaction in the cell is supplied via a compressor drawing air from the atmospheric environment. The efficiency of the fuel cell reaches up to 60% and by this easily outscores modern internal combustion engines (up to 40%) however, still considerable heat is created which is dissipated by a large cooler. This is also necessary, because the material used in the modules only bears a maximum temperature of 80°C.

Safety by Nitrogen

Additionally, nitrogen is on board what may seem surprising at first. However, this inert gas is a safety element. It automatically rinses the system after each switch-off with nitrogen to remove the remaining hydrogen from the system.

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Because, the remaining hydrogen in the system reacts to water, there is a pressure difference of approximately one bar at the membrane, creating a mechanical strain which would reduce the intended life time of 20,000 operating hours. Here as well, the nitrogen solves the problem.

Intended Lifetime of 20,000 Operating Hours

As a prerequisite for the applicability to the series production, several questions still need to be addressed. One is the frost resistance of the system. The truck can operate out-doors also at temperatures below 0°C, however, freezing, especially of the PEM cell must be avoided, because ice crystals could impair the membrane. As corresponding solutions are currently being developed for automotive applications an appropriate technology should soon be available for fork lift trucks. Further, there is not yet enough experience with respect to the life time, which is with 20,000 operation hours considerably higher than the expected lifetime for automotive applications with 3,000 hours. Thirdly, both aspects affect the economy, here the costs are not yet equivalent to internal combustion engines or batteries. However, for this early point in the development, this is normal.

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Once again, Still has given proof of its innovative performance. For Europe's leading producer of electric fork lift trucks, the step towards fuel cell technology is logical, because the drive technologies are closely related. Compared to combustion, the creation of electric energy by a chemical reaction offers important advantages: These include the high efficiency, the emission-free operation and the low operating temperature. In this sense the project in Munich is surely a first step only, nonetheless a highly important one.

Bildunterschriften:

Hydrogen fuel: Together with partners Still presents a fuel cell driven fork lift truck based on the R60.

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Optimum energy use: The fuel cell is not only environmentally friendly with respect to emissions, its energy efficiency of up to 60 percent is also extremely effective.

Photo: STILL GmbH

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