Developing Hybrid–Power Fuel Cells with a Low–Pressure Hydrogen–Storage System used in an Electric Forklifts

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In this study, we prepared a lab–built water–cooled fuel cell hybrid power system. This system contains 2.7 kW proton exchange membrane fuel cells, ultracapacitors, and lithium batteries that are actually constructed in a commercial electric forklift, APT–20. This hybrid system can conform to the working state of a typical electric forklift, providing lifting loads of 1000 kg at 4 kW. This system is designed to control the fuel cell so as not to exceed its own power generating capacity of 74% in operation, so it is coupled with a fluctuating load of a set of small fuel cells to assist in balancing power. For maximum power output to the lift motor, it is coupled with a set of independent supply lift motors to increase kinetic energy and improve the overall output state. The fuel supply is a low–pressure hydrogen–storage system, consisting of four tanks of low–pressure steel hydrogen–storage cylinders to be used by the fuel cell. It thus provides a safer hydrogen–storage method for use in factory transport vehicles. By designing two sets of auxiliary power sources with different powers, it is anticipated that the fuel cell output can be maintained at 1.8 kW to 2 kW, such that the fuel cell has stable output and prolonged life–span, and can be maintained under a good working environment, and that the overall system has maximum effectiveness in supplying the necessary kinetic energy according to the usage requirements.

Keywords: hybrid power systems, proton exchange membrane fuel cells, lithium–ion battery, ultracapacitor circuits, power management.

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