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C1Po2A-05 [20]: Design of a Cryogenic-compressed Hydrogen Storage and Supply System for Fuel Cell Stacks of Heavy Trucks

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The work presents the design and validation of a novel cryogenic-compressed hydrogen (CCH2) storage and supply system. This CCH2 system is designed to operate at the pressure up to 20MPa and temperature down to 20K. It is developed to provide an efficient and stable approach to storage and supply hydrogen for heavy trucks, powered by fuel cell stacks. The core strategy of process design and pipeline arrangement is the calculation of thermodynamic equilibrium. In general, thermal energy occupies nearly half of fuel cell's outcome, which cannot be converted into truck's dynamic system. But in a CCH2 system, this energy can be used to heat cool hydrogen and reduce the cooling power by air heater. Then the entire efficiency can be increased. This process is carefully designed and demonstrated for a 25 tons truck. Massflow rate and pipe diameters in the CCH2 system are verified by theoretical calculating and simulating, based on thermodynamic principles. Also, Self-pressurization technology has been applied in this system to compensate for the pressure loss due to hydrogen outflow. At last, the selection of cryogenic valves, stainless steel pipes is strictly carried out. This paper explains operating mechanism and design consideration of the CCH2 system, introduces its selection of relevant equipment and presents the preliminary test results.

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