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Mobile fuel cell system based on a diesel steam reformer and a PEFC

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Abstract

Fuel cell systems based on diesel steam reforming and polymer electrolyte fuel cells (PEFC) offer a great potential for auxiliary power units (APU) in mobile applications. In a joint research project with partners from industry, Oel-Waerme-Institut GmbH is developing an integrated fuel cell system for mobile power generation in caravans and yachts. The system is based on a diesel steam reformer and allows the operation of low-temperature (LT-) as well as high-temperature (HT-) PEFC. In preceding investigations of the author's group, coupled operation of a steam reformer with an LT-PEFC was demonstrated using a sulfur-free surrogate fuel [1, 2]. Furthermore, the results of a fuel processor optimization regarding start-up, system integration, reformer geometry, and reformer catalyst performance have been reported.

The focus of this work is the coupled operation of the steam reformer and an LT-PEFC using logistic diesel from a gas station as a fuel. An optimized reformer catalyst was used for these investigations, which has shown excellent performance with regards to fuel conversion for a thermal input of up to 10 kW even at reformer temperatures as low as 700 °C. A single-stage preferential oxidation reactor was included to achieve the CO concentration required by the LT-PEFC. The effect of sulfur and residual hydrocarbons on the PEFC performance was investigated. The system design was optimized for fast system start-up and high system efficiency. Based on the results of the optimization, an autarkic fuel processor with balance of plant components for stand-alone operation is developed.

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