International Journal of Hydrogen Energy
Volume 51, Part D, 2 January 2024, Pages 1156-1170

Development and analysis of a new method in developments of molten carbonate fuel cell technology, based on hybrid supercritical carbon dioxide for multi objective optimization based on machine learning techniques

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Abstract

Electricity is produced by electrochemical reactions in devices known as Solid Oxide Fuel Cells (SOFCs), which are renowned for their high efficiency, minimal emissions, great fuel flexibility, lack of moving parts, and quiet operation; however, the counterpart of them the molten carbonate fuel cells are less in attention. The present study deals with an MCFC-based supercritical CO_2 recovered system for generating high-efficiency power and cooling based on energy from biomass. The system is modeled, and the key design variables' effect is foreseen. Using MATLAB, the machine learning techniques are implied to reduce the emission and LCOP while keeping the efficiency at its highest value. The results indicate that Current density, fuel utilization factor, cell temperature, and pressure ratio have a critical effect on system performance. Also, the efficiency reduces by reducing cell voltage due to an increase in current density and reaching 52%. Increasing fuel utilization factor causes a 7% drop in net power production. Finally, At the best solution point, Levelized product cost of 0.11 ($/kWh), an exergy efficiency of 56.5%, and a CO_2 emission of 0.35 kg/kWh are reached.