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Energy and Exergy Analysis of Anode-Supported and Electrolyte–Supported Solid Oxide Fuel Cells Gas Turbine Power System

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Abstract : Solid oxide fuel cells (SOFCs) are one of the most promising technologies since they can produce electricity directly from fuel and generate a lot of waste heat that is generally used in the gas turbines to promote the general performance of the thermal power plant. In this study, the energy, and exergy analysis of a solid oxide fuel cell/gas turbine hybrid system was proceed in MATLAB to examine the performance characteristics of the hybrid system in two different configurations: anode-supported model and electrolyte-supported model. The obtained results indicate that if the fuel utilization factor reduces from 0.85 to 0.65, the overall efficiency decreases from 64.61 to 59.27% for the anode-supported model whereas it reduces from 58.3 to 56.4% for the electrolyte-supported model. Besides, the overall exergy reduces from 53.86 to 44.06% for the anode-supported model whereas it reduces from 39.96 to 33.94% for the electrolyte-supported model. Furthermore, increasing the air utilization factor has a negative impact on the electrical power output and the efficiencies of the overall system due to the reduction in the O_2 concentration at the cathode-electrolyte interface.

Keywords : solid oxide fuel cell, anode-supported model, electrolyte-supported model, energy analysis, exergy analysis
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