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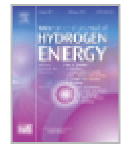

Design of a biomass-fueled system to produce hydrogen/power: Environmental analyses and Bi-objective optimization

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Abstract

Due to the fact that biomass fuel is capable of powering multi-generation systems, has a high-efficiency performance, and produces fewer harmful gases, biomass fuel can prove to be a valuable heat source. In this regard, this study introduces a new biomass-fueled power and hydrogen generation scheme. There are three subsystems involved in the study: a biomass-based gas turbine cycle, a steam flash cycle, and an electrolyzer unit. To begin, a parametric analysis is performed on the system from the perspectives of thermodynamics, thermoeconomic, and the environment. As a next step, four effective variables are evaluated for single-objective and bi-objective optimizations in order to determine the optimal working conditions. The results of bi-objective optimization indicate 48.78% and 41.40% energy and exergy efficiencies for the presented system, separately, with 8093 kW output power, 86.1 kg/day hydrogen production, 8684 t/MWh CO_2 emission, and 27.9 $/MWh Levelized Cost of Product. Compared to the base condition, hydrogen production grows 29.78%, but output power drops by 1.14%. Furthermore, hydrogen Production Optimum Design accounts for the maximum amount of hydrogen production in optimal conditions, producing 94.73 kg/day. The gasifier destroys the most exergy under base and optimum conditions.