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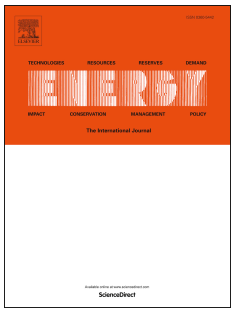

Thermodynamic assessment of a solar/autothermal hybrid gasification CCHP system with an indirectly radiative reactor

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Thermodynamic assessment of a solar/autothermal hybrid gasification CCHP system with an indirectly radiative reactor

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Abstract

The solar/autothermal hybrid gasifier (SAHG) is an attractive approach to provide continuous production of the syngas via coupling autothermal and solar gasification together, where the SAHG mainly includes fully solar, hybrid, and fully autothermal modes. An ICE CCHP system driven by the SAHG with an indirectly irradiative two-cavity reactor introduced conceptually and investigated thermodynamically. Considering the effects of solar flux inputs and various reactant ratios, a zero-dimensional steady-state model of the SAHG was established by using Gibbs free energy minimization, and was validated with the reported data. The optimal steam-to-feedstock and oxygen-to-feedstock ratios has been achieved based on the restrictions of temperature over 1000 K and minimization of steam input. The results of two consecutive days indicate mole flow rates of H_2 and CO were increased by over 38.8% and 11.8%, respectively, leading to an increment in LHV_s by 51.7%. An increment in primary energy ratio by 11.5% can be achieved by using the SAHG-CCHP system. The yearly assessment