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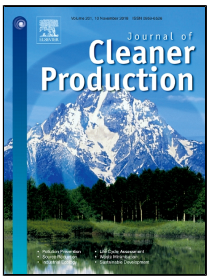

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Exergy and exergoeconomic analyses of a combined cooling, heating, and power (CCHP) system based on dual-fuel of biomass and natural gas

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Abstract

Dual fuel of biomass and natural gas can provide a cost effective and reliable method of simultaneously using renewable energy and fossil energy, and it offers advantages such as flexibility and environmental friendliness. In this paper, a dual fuel combined cooling, heating, and power (CCHP) system primarily composed of a gasifier, gas conditioning unit, gas storage tank, internal combustion engine (ICE), absorption chiller/heater, and heat exchanger is proposed as an energy supply system for a hypothetical hotel. The system is analyzed and evaluated from the viewpoint of thermodynamics and exergoeconomics under design conditions in summer and winter seasons. The exergy efficiencies, exergy losses, and exergoeconomic behaviors of each component in the system are calculated and analyzed; then, the exergoeconomic costs of chilled water, heating water, electricity, and domestic hot water are calculated. Furthermore, a sensitivity analysis is performed to evaluate the impact of fuel prices on the unit exergy cost of the products. The results indicate that the exergy efficiencies of the system in summer and winter are 8.06% and 12.23%, respectively. Exergy loss analyses indicate that the largest loss occurs in the gasifier and accounts for more than 60% of the total exergy losses. Exergoeconomic analysis shows that the unit exergoeconomic cost of the products is higher in winter than in summer. Sensitivity analysis demonstrates that the products are more sensitive to the price of natural gas than biomass.

Key words: Combined cooling, heating, and power (CCHP) system; Biomass gasification; Exergy analysis; Exergoeconomic analysis; Sensitivity analysis.

Highlights:

(1) Proposed a dual-fuel CCHP system based on biomass and natural gas.
(2) Presented the exergy and exergoeconomic analysis of the dual-fuel CCHP system.
(3) Discussed multiproducts' cost influenced by the fuel price.

Nomenclature

Abbreviation

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