








Enhancing efficiency and reducing CO₂ emission of a geothermal-driven polygeneration system: Environmental analysis and optimization

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Abstract

The limitations of the single-flash cycle (SFC) include low efficiency, limited power output, and the inability to produce multiple products simultaneously. Additionally, the SFC requires a large amount of water and can have negative environmental impacts. In this study, to improve performance and produce multiple products, subsystems such as a branched GAX cycle assisted by a thermoelectric generator, a domestic water heater, and a reverse osmosis unit are coupled with the SFC. Then, thermodynamic, environmental, sustainability, and net present value approaches are devoted to analyzing system performance. This study utilizes MATLAB software to achieve a two-objective optimization that uses both CO₂ emission rate and exergetic efficiency as objectives. The CO₂ emissions rate represents a downward inclination with an increase in temperature in the generator inlet. Net electricity, cooling load, and pure water rate have a downward inclination with an augmentation of the temperature in the generator inlet due to reducing mass flow rate in the branched GAX/TEG cycle. At the optimum point, the payback period of the designed system with increasing selling prices of the products is decreased. The polygeneration gain output ratio in the optimized conditions reduces compared to the base case, whereas the sustainability index increases. Compared to similar works, the designed system produces a higher output.
