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Exergy and Energy Analysis of Regenerative Solar-driven Dual-loop ORC with Nanofluid Solar Subsystem

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ABSTRACT

A thermodynamic analysis of a regenerative solar-driven combined cooling, heating and power system of dual-loop organic rankine cycle (DORC) with flat plate solar collectors is conducted to determine the energy and exergy efficiency of the system, exergy destructions and losses along with their magnitudes and exact locations. The DORC consists of a high-temperature and a low-temperature loop, and nanofluid is used in the solar thermal sub-system to improve the heat absorption from solar collectors. In this study two recuperators are added to the DORC to improve the performance of the regenerative organic Rankine cycle and its effect on the overall produced power. The impact of connecting cooling by adding an ejector refrigeration cycle in the high-temperature loop is explored using an exergy analysis. The performance of the regenerative DORC using nanofluid in comparison to the regular DORC counterpart is discussed in terms of energy and exergy efficiencies. Energy and exergy analysis is presented to determine the irreversibilities within the systems, and based on the location of the irreversibilities, improvements are implemented. It was found that implementing recuperators in the proposad configuration increased the thermal energy efficiency and exergy efficiency by 5% and 4%, respectively.