

Article

A Comparative Exergoeconomic Analysis of Waste Heat Recovery from a Gas Turbine-Modular Helium Reactor via Organic Rankine Cycles

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Abstract: A comparative exergoeconomic analysis is reported for waste heat recovery from a gas turbine-modular helium reactor (GT-MHR) using various configurations of organic Rankine cycles (ORCs) for generating electricity. The ORC configurations studied are: a simple organic Rankine cycle (SORC), an ORC with an internal heat exchanger (HORC) and a regenerative organic Rankine cycle (RORC). Exergoeconomic analyses are performed with the specific exergy costing (SPECO) method. First, energy and exergy analyses are applied to the combined cycles. Then, a cost-balance, as well as auxiliary equations are developed for the components to determine the exergoeconomic parameters for the combined cycles and their components. The three combined cycles are compared considering the same operating conditions for the GT-MHR cycle, and a parametric study is done to reveal the effects on the exergoeconomic performance of the combined cycles of various significant parameters, e.g., turbine inlet and evaporator temperatures and compressor pressure ratio. The results show that the GT-MHR/RORC has the lowest unit cost of electricity generated by the ORC turbine. This value is highest for the GT-MHR/HORC. Furthermore, the GT-MHR/RORC has the highest and the GT-MHR/HORC has the lowest exergy destruction cost rate.