Fluid selection of Rankine cycle for utilization of waste heat from GT-MHR: the energy and exergy viewpoints

Farzad Mohammadkhani, Naser Shokati, Faramarz Ranjbar, Mortaza Yari
PhD Student, University of Tabriz, f.mohammadkhani@tabrizu.ac.ir
PhD Student, University of Tabriz, n_shokati@tabrizu.ac.ir
Assistant Professor, University of Tabriz, s.ranjbar@tabrizu.ac.ir
Associate Professor, University of Tabriz, myari@uma.ac.ir

Abstract

The Gas Turbine-Modular Helium Reactor (GT-MHR) is currently being developed by the international community. In this power plant, circulating helium that has to be compressed in a single or two successive stages cools the reactor core. For thermodynamic reasons, in these systems a huge amount of energy is rejected. In this work, a thermodynamic analysis is reported for a combined system with a net electrical output of 299 MW in which the waste heat from the GT-MHR is utilized by two Rankine cycles. To achieve the best results, different working fluids are examined in Rankine cycles and performance of the combined cycle is determined for each case from the energy and exergy viewpoints. Finally a parametric study is performed to reveal the effects of some decision variables on the performance of the system. The results show that selection of different working fluids has the noticeable effect on energy and exergy performance of the combined cycle. It is concluded that, the combined cycle with Isopentane as a working fluid for the Rankine cycles, has the highest work produced as well as energy and exergy efficiencies, among the 6 considered working fluids. Also Rankine cycle with steam results the highest exergy destruction in the combined cycle.

Keywords: GT-MHR, Rankine cycle, Energy, Exergy, Parametric study