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Thermodynamic analysis of dual steam-organic Rankine cycle used in waste heat recovery from exhaust and coolant of a Diesel engine

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Abstract

A thermodynamic analysis is reported for waste heat recovery from the exhaust gas and coolant of OM 352 Diesel engine using dual steam-organic Rankine cycle, in which, high temperature loop utilizes waste heat of the exhaust gas and low temperature loop recovers engine coolant heat as well as residual heat of the high temperature loop. For the best results, four organic working fluids are examined in the low temperature loop. Energy and exergy relations are developed for the dual cycle components and exergy efficiency as well as exergy destruction values are calculated for the components. Finally, a parametric study is performed to reveal effects of condenser pressure of the high temperature loop on the cycle thermodynamic performance. Results show that the dual cycle with toluene in the low temperature loop has the best performance so that employing the dual cycle increases the system produced power by 25.9%. The dual cycle exergy efficiency is calculated to be 58.15%. Also, the parametric study shows that the dual cycle produced power has an optimum point with respect to the condenser pressure of the high temperature loop.

Keywords: waste heat recovery, Diesel engine, Rankine cycle, exergy analysis, parametric study