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Performance optimization of a subcritical ORC, supercritical ORC, and trilateral Rankine cycle power plant with a heat source temperature of 260°C 280°C and 300°C

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Abstract. Industrial processes generate waste heat. To transform waste heat into usable electrical energy, a subcritical organic ORC (organic Rankine cycle), supercritical ORC, and Trilateral Cycle (TLC) power plants are proposed in this study. A MATLAB code for golden section search was developed. The code can optimally determine the evaporation pressure, condensation pressure, and working fluid mass flow rate that are matched with the heat source and heat sink temperature simultaneously. The heat source temperatures investigated are at 260°C 280°C and 300°C. The results show that the optimal working fluid that provides the highest net power output for the subcritical ORC plant is the one that its critical temperature is 35 - 65°C below the heat source temperature. Meanwhile, it was also found that the optimal working fluid that provides the highest net power output for the supercritical plant is the one that its critical temperature is 20 - 45°C below the heat source temperature. On the other hand, the optimal working fluid that provides the highest net power output for the TLC plant is the one that its critical temperature is 35 - 75°C above the heat source temperature. Furthermore, the off-design performances of those plants were investigated when the heat source temperatures were varied in the range of 255 - 305°C. It was found that the net power output can be regulated by a proper adjustment of the operating conditions such as evaporation and condensation pressures.

Keywords: subcritical ORC, supercritical ORC, trilateral Rankine cycle, waste heat recovery**,** working fluid selection