Thermodynamic evaluation of the Kalina split-cycle concepts for waste heat recovery applications - DTU Orbit (04/01/2019)

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The Kalina split-cycle is a thermodynamic process for converting thermal energy into electrical power. It uses an ammonia–water mixture as a working fluid (like a conventional Kalina cycle) and has a varying ammonia concentration during the pre-heating and evaporation steps. This second feature results in an improved match between the heat source and working fluid temperature profiles, decreasing the entropy generation in the heat recovery system. The present work compares the thermodynamic performance of this power cycle with the conventional Kalina process, and investigates the impact of varying boundary conditions by conducting an exergy analysis. The design parameters of each configuration were determined by performing a multi-variable optimisation. The results indicate that the Kalina split-cycle with reheat presents an exergetic efficiency by 2.8% points higher than a reference Kalina cycle with reheat, and by 4.3% points without reheat. The cycle efficiency varies by 14% points for a variation of the exhaust gas temperature of 100 °C, and by 1% point for a cold water temperature variation of 30 °C. This analysis also pinpoints the large irreversibilities in the low-pressure turbine and condenser, and indicates a reduction of the exergy destruction by about 23% in the heat recovery system compared to the baseline cycle.

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