Design and optimization of combined rankine cycle for waste heat recovery of a coal power plant using LNG cryogenic exergy

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In this study, a combined Rankine cycle was modeled and optimized. By integrating the CO2-Organic Rankine cycle (ORC) with the steam cycle and a liquefied natural gas (LNG) evaporation process, the combined cycle is able to extract additional power without consuming additional fossil fuel. Unlike conventional ORC, the CO2-ORC utilizes the low grade waste heat only for super heating of working fluid while main evaporation process is achieved by sea water. The CO2 condensation process in the ORC takes place lower than the ambient temperature by coupling with the LNG evaporation system. Furthermore, fraction of liquefied CO2 is purged for the sequestration. Therefore, CO2 liquefaction can be achieved without additional refrigeration cycle. This process not only produces more power with same fuel consumption but reduces CO2 removal energy. The gross power is increased from 42.21 to 90.54 MWe and total CO2 removal energy is decreased about 9%. The optimum design and operating conditions were also obtained through parameter sensitivity analysis.