Part-load performance of a high temperature Kalina cycle

The Kalina cycle has recently seen increased interest as an alternative to the conventional steam Rankine cycle. The cycle has been studied for use with both low and high temperature applications such as geothermal power plants, ocean thermal energy conversion, waste heat recovery, gas turbine bottoming cycle, and solar power plants. The high temperature cycle layouts are inherently more complex than the low temperature layouts due to the presence of a distillation-condensation subsystem, three pressure levels, and several heat exchangers. This paper presents a detailed approach to solve the Kalina cycle in part-load operating conditions for high temperature (a turbine inlet temperature of 500 °C) and high pressure (100 bar) applications. A central receiver concentrating solar power plant with direct vapour generation is considered as a case study where the part-load conditions are simulated by changing the solar heat input to the receiver. Compared with the steam Rankine cycle, the Kalina cycle has an additional degree of freedom in terms of the ammonia mass fraction which can be varied in order to maximize the part-load efficiency of the cycle. The results include the part-load curves for various turbine inlet ammonia mass fractions and the fitted equations for these curves.