Thermodynamic optimisation and analysis of four Kalina cycle layouts for high temperature applications - DTU Orbit (06/01/2019)

Thermodynamic optimisation and analysis of four Kalina cycle layouts for high temperature applications
The Kalina cycle has seen increased interest in the last few years as an efficient alternative to the conventional steam Rankine cycle. However, the available literature gives little information on the algorithms to solve or optimise this inherently complex cycle. This paper presents a detailed approach to solve and optimise a Kalina cycle for high temperature (a turbine inlet temperature of 500°C) and high pressure (over 100bar) applications using a computationally efficient solution algorithm. A central receiver solar thermal power plant with direct steam generation was considered as a case study. Four different layouts for the Kalina cycle based on the number and/or placement of the recuperators in the cycle were optimised and compared based on performance parameters such as the cycle efficiency and the cooling water requirement. The cycles were modelled in steady state and optimised with the maximisation of the cycle efficiency as the objective function. It is observed that the different cycle layouts result in different regions for the optimal value of the turbine inlet ammonia mass fraction. Out of the four compared layouts, the most complex layout KC1234 gives the highest efficiency. The cooling water requirement is closely related to the cycle efficiency, i.e., the better the efficiency, the lower is the cooling water requirement.

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