Abstract

Binary fluid system has an efficient system of heat recovery compared to a single fluid system due to a better temperature match between hot and cold fluids. Kalina cycle system (KCS) is a vapor absorption power cycle developed from the improvement of Rankine cycle system. KCS plants are not well developed at high sink temperature of hot climatic conditions. In this work, three KCS configurations have been investigated to operate at low temperature (LT), medium temperature (MT) and high temperature (HT) heat recoveries integrated with solar concentrating collector. Thermodynamic processes, involved in binary mixture plants have been formulated and evaluated to develop thermodynamic model for KCS configurations after the properties generation. A new and improved methodology has been developed to solve low temperature Kalina cycle system (LTKCS), medium temperature Kalina cycle system (MTKCS) and high temperature Kalina cycle system (HTKCS) plants. The key operational parameters have been identified and its influence has been analyzed on energy and exergy performance to recommend the efficient running conditions for the three configurations considered. The results can be used for selection of operation conditions in boiler, separator and turbine to maximize the power output and efficiency of the plant. The equipment sizing and cost have been evaluated at the developed optimized conditions.

In LTKCS, the range in operational conditions is widened by considering a change in separator vapor fraction instead of separator inlet concentration. A high temperature regenerator (HTRGN), economizer and evaporator are serially connected in a regular LTKCS. But it results low performance due to low heat recovery in HTRGN. It can be solved by sharing of heat load between HTRGN and boiler (economizer + partial evaporator) based on available heat with parallel arrangement in place of serial. The results show that parallel arrangement results high efficiency compared to series arrangement in source heaters. A new KCS configuration has been developed to suit the MT heat recovery with power augmentation. Nearly 30% of extra working fluid has been found in turbine compared to other configurations. Finally KCS operational conditions for HT heat recovery have been developed to augment the power from 250 ºC to 550 ºC of heat source. The cycle energy efficiencies for LTKCS, MTKCS and HTKCS are 12%, 20% and 23% respectively.