Thermodynamic and economic analysis of solar assisted CCHP-ORC system with DME as fuel

A solar assisted combined cooling, heating and power system coupled with an organic Rankine cycle (SCCHP-ORC) is proposed and investigated via both experimental and simulation methods. The dimethyl ether (DME) is used as the fuel of the proposed system for the prime mover (PM) and auxiliary boiler (AB). DME was chosen based on that it is friendly to the environment and avoids low temperature corrosion. The performance of the proposed system was evaluated during typical summer and winter days via a case study using thermodynamic and economic methods. The results show that the proposed system followed by the electricity load (FEL) strategy can satisfy most of the electricity demand. The cooling and heating profiles are supplied by utilizing the PMs’ cooling water and the parabolic trough collector (PTC). Additionally, the released energy from a thermal energy storage (TES) can significantly reduce the need for grid energy during peak load hours. Moreover, the efficiency of the proposed SCCHP-ORC system is higher than that of original system by 9.87%. The minimum values of carbon dioxide emission saving ratio are of 58.14% during summer and 17.32% during winter. The total amount of carbon dioxide saved are 778.7 kg/day during a typical summer day and 358.7 kg/day during a typical winter day due to the technologies selected in this system. Besides, the sensitivity analysis shows that the changed electricity price has a largest impact on the payback period ranging from 4.0 year to 6.5 year.