Dynamic modeling of gas engine driven heat pump system in cooling mode

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Abstract

The Gas Engine driven Heat Pump (GEHP) operating cycle is a vapor compression refrigeration type which includes compressor, condenser, expansion valve, evaporator, and a gas engine to drive the compressor. In the present work, the dynamic modeling of GEHP system during startup in cooling mode is performed and variation of evaporator and condenser temperatures, shaft power consumed by compressor, engine fuel consumption, and primary energy ratio of system were determined at various time steps. The dynamic modeling included transient heat transfer equations for condenser and evaporator for computing the evaporator and condenser temperatures. These equations were solved using Runge-Kutta method. In order to validate dynamic modeling, the modeling output results were compared with the empirical results obtained for a GEHP system. The comparison of modeling results and the experimental measured values for various amounts of evaporator and condenser temperatures, cooling capacity, gas engine fuel consumption, shaft power consumed by compressor and primary energy ratio of system showed average difference values of 1.73 °C, 1.26 °C, 8.05%, 9.51%, 9.27% and 7.15% respectively.

Keywords: Gas engine driven heat pump, vapor compression refrigeration cycle, dynamic modeling, transient heat transfer, gas engine.

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