

Simulation of a CO₂ Transcritical Cycle for Air Conditioning

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Due to its thermophysical properties, a CO₂ transcritical cycle is greatly different from a conventional subcritical cycle. Consequently, existing computational models developed for conventional heat pump and refrigeration cycles are not appropriate for performance evaluation of a CO₂ based cycle, and a new prediction method is required. In the present study, a steady-state model of a CO₂ transcritical cycle for air conditioning, which consists of a rotary compressor, a cross-counter flow gas cooler, a cross-parallel flow evaporator, an expansion device and connecting tubes, has been developed. In the compressor model, several kinds of flow and power losses have been considered. In addition, a detailed model of the fin-tube heat exchanger has been constructed by means of the finite volume method, in which the local heat transfer and flow characteristics are evaluated according to the literature correlations, and the effects of dew condensation on the evaporator surface are considered. Then, as a calculation example, the effects of the discharge pressure and air humidity on the cycle performance have been examined with this developed simulator.