

A Study on the Dynamic Characteristics of the Heat Pump Clothes Dryer System with R290 Refrigerant

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Abstract

Nowadays, HFCs are mainly used as refrigerants in heat pump clothes dryers. However, it is essential to replace the conventional HFCs with alternative refrigerants owing to their high GWP. R290 is considered as the most appropriate alternative refrigerant for heat pump clothes dryers owing to its prominent performance. A heat pump clothes dryer exhibits transient characteristics because the heat pump cycle and air cycle are combined, showing close interaction between the two cycles. Thus, it is required to consider the transient characteristics when analyzing the heat pump clothes dryer. In this study, a transient simulation of a heat pump clothes dryer using R290 is developed and validated with the experimental data. The developed simulation well predicts the behavior of the cycle under various operating conditions according to the compressor operating frequency. The difference between the experimental and predicted data by the simulation is within $\pm 7\%$ error for the compressor power consumption, refrigerant mass flow rate, and evaporation and condensation pressures. The developed simulation in this study can be used to optimize the compressor control logic and the geometry of the heat exchangers to improve the drying performance as well as to reduce the drying time.

Keywords: Heat pump clothes dryer, Alternative refrigerant, R290, Transient simulation, Heat and mass transfer,