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Analytical Study on the Vapour Injection Scroll Compressor

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Extended Abstract

A heat pump is a device that is able to transfer heat from one fluid at a lower temperature to another at a higher temperature. The critical demerit of the vapour compression heat pump is that the capacity of the heat pump decreases when the outdoor temperature is low because the suction gas density at the compressor inlet decreases. Vapour injection has been widely applied to the heat pump in order to solve the performance degradation of the heat pump in cold weather conditions. Vapour injection decreases not only the refrigerant discharge temperature but the irreversibility of the compression process. However, research on the correlation for injection scroll compressor efficiencies are limited. In this study an IHX type vapour injection heat pump is constructed to investigate the relationship between the operating parameters and compressor efficiency. A simulation program that predicts the vapour injection compressor performance was developed. Leakage, heat transfer, and geometrical characteristics of the injection scroll compressor were considered in the simulation program. In order to calculate the overall heat and mass transfer characteristics of vapour injection scroll compressor, a loss and efficiency model was applied. The change rates of the refrigerant properties were calculated by the 4th Runge-Kutta method with every orbiting angle change from suction to discharge process. Based on the simulation program, the equations predicting the volumetric efficiency, isentropic efficiency, and mechanical efficiency were developed. The correlations included injection parameters, compressor speed, operating pressures, and temperatures. The estimated mass flow rate, discharge temperature and compressor work were within ±5%, ±7%, and ±3 K, respectively, compared to experimental results. Based on the correlations, the effect of each operating parameters on the injection compressor performance can be explained.

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