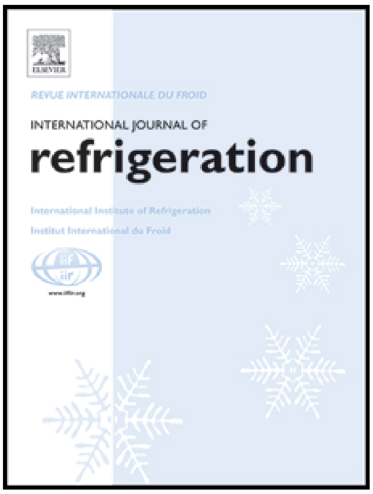

Two-phase injected and vapor-injected compression: Experimental results and mapping correlation for a R-407C scroll compressor

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Two-phase injected and vapor-injected compression: Experimental results and mapping correlation for a R-407C scroll compressor

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Abstract. Vapor compression systems in hot climates tend to operate at higher pressure ratios, leading to increased discharge temperatures, higher irreversibilities during compression, lower specific enthalpies differences across the evaporator, and possibly a reduction in the compressor life due to the breakdown of the oil. To counter these effects, the use of economized, vapor injection compressors is proposed for vapor compression systems in high temperature climates. Such compressors are commercially available however an accurate method for mapping single-port injection compressors is unclear. This paper establishes compressor maps for a single-speed R-407C scroll compressor with two-phase injection and vapor-injected compression. A dimensionless-PI correlation for mapping the injection ratio, refrigerant discharge temperature, compressor power consumption, overall isentropic and volumetric efficiencies, and the heat loss ratio for these compressor maps and a variable speed R-410A compressor with vapor injection is presented. The mapping results are compared to the AHRI 10-coefficient polynomial and another proposed correlation.

Keywords: Liquid-vapor injected compression, vapor-injected compression, air-conditioning, compressor mapping, liquid-vapor injection, vapor-injection

1 Introduction

It is well documented that heat sink and source temperatures strongly influence vapor compression system performance. HVAC&R systems operating in extreme temperature climates are required to operate at higher pressure ratios. The system refrigeration capacity and efficiency decline with higher condensing temperatures and lower evaporating temperatures. Lower system performance is attributed to an increase in irreversibilities during compression, and higher compressor discharge temperatures. As the pressure ratio or temperature lift requirement increased, single-stage vapor compression cycles become increasingly inefficient and the use of two-stage or multi-stage cycles become the best thermodynamic solution. However, the component complexity and costs of those systems require higher investment. Economized vapor injection cycles as shown in Figure 1 have been considered as a possible compression method to achieve quasi-isothermal compression resulting in lower discharge temperatures and additional cooling capacity. Reducing the discharge temperature is especially important because higher discharge temperatures can result in additional wear on the compressor,