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Experimental Study on the Performance Characteristics of a Vapour Compression Refrigeration Cycle using an Ejector

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Extended Abstract

Recently, it is desired to reduce power usage for air-conditioning in public buildings. Extensive studies have been carried out to enhance energy efficiency of a refrigeration cycle. Generally, a conventional vapour compression refrigeration cycle uses capillary, TXV, or EEV as an expansion device. The expansion process through these devices is assumed to be an isenthalpic process. Along the process, energy loss occurs due to friction and swirl motion of the flow. In order to recover the potential kinetic energy in the expansion process, various possible methods of the expansion process have been proposed. An ejector, which is a possible replacement of conventional expansion devices such as a capillary tube and thermostatic expansion valve, has been proposed to save energy during the expansion process in the refrigeration cycle. The ejector is designed to recover the throttling energy loss (Mahesh and Valiya, 1999), which may lead to an isentropic process.

The objective of this study is to investigate the performance characteristics of an ejector designed for a vapour compression cycle. The performance of the vapour compression cycle using the ejector was measured by varying operating conditions and ejector geometries. The compressor is a reciprocating type with a variable speed inverter ranging from 25 Hz to 45 Hz by an inverter driver and a cylinder volume of 15*cm3 per revolution. The double tube type heat exchanger was used condenser and a heater was used as an evaporator. This study mainly discussed pressure lifting ratio in terms of entrainment ratio. The pressure lifting ratio means the ratio of the exit pressure to the suction pressure, and the entrainment ratio indicates the mass flow rate ratio of the secondary to the total flow. The pressure lifting ratio and total mass flow rate decreased with the increase in the entrainment ratio due to the decreased effect of the primary nozzle and the decreased compressor suction pressure. The pressure lifting ratio and total mass flow rate increased with the increase in the compressor speed due to the accelerated motive flow with the compressor speed. At the low entrainment ratio, the pressure lifting ratio of smaller mixing section diameter was higher than that of larger mixing section diameter. At the high entrainment ratio, the pressure lifting ratio of larger mixing section diameter was higher than that of smaller mixing section diameter.

References

[1] N. Mahesh and N. Valiya, "Investigation of Single and Two-phase Flow Ejectors," Ph.D. thesis, University of Maryland, Adelphi, Maryland.