THESIS INFORMATION

Title:	**Research on integrating ejector operated by low-grade heat sources into compressor refrigeration system to meet air conditioning demands**
Major:	**Thermal Engineering**
Major code:	**62.52.01.15**
PhD student:	**Nguyen Trung Kien**
Advisor:	**Prof. Dr Le Chi Hiep**
University:	**University of Technology, Vietnam National University, HCMC**

Abstract:

The thesis presents the possibility of integrating ejector operated by low-grade heat sources into air-conditioners with vapour compressor refrigerator to satisfy air conditioning demands. In chapter 2, the author presents the theoretical background of the ejector - air-compressor cascade cycle, the ejector-design equations and the ejector simulation method. In chapter 3, the author developed 3 models: integrated cycle, R134a-ejector design and ejector-simulation models. From these models, the author analyzes and evaluates the impact of operating conditions on the efficiency of the system, and demonstrates a relationship between ejector dimensions and operating conditions. A CFD simulation allows the optimization of ejector geometry for experimental purposes. In chapter 4, the author presents the experimental setup, the main components used in the experiment, as well as the instrument and control equipment. In chapter 5, the experimental model is built to validate theoretical facts and evaluate the feasibility of integrating ejector into air-conditioning systems with vapour compressor refrigerator. Four ejectors with different area ratios were tested, and the most effective ejector was chosen. The results of integrating ejector into the vapour compressor conditioner indicate that the integrated system can save 21,7% -30,7% of power consumption.

Contributions of the thesis:

1. A program was built to analyse ejector– vapour compressor cascade refrigeration system. Many refrigerants were used in the calculation, and R134a was chosen in ejector sub-cycle and R410A was chosen in compressor sub-cycle. It is suitable for the experimental conditions in Vietnam.

2. Energy and exergy analysis of an ejector– vapour compressor cascade refrigeration system was performed with R134a-R410A refrigerant pair. From this analysis, the author determined the influence of generator temperature, condenser temperature, evaporator temperature and intercooler temperature on the operating efficiency of the system. The system was evaluated by two separate thermal COP, mechanical COP and optimal intercooler temperature determined based on the minimum total exergy loss. The results show that the optimal intercooler temperature is 26.5°C under the conditions that Tg = 80°C, Tc = 34°C, Te = 0°C. These results have been published in the Journal of Thermal Analysis and Calorimetry (SCIE, IF = 2.731).

3. A relationship between the ejector dimensions (nozzle diameter, nozzle outlet diameter, throat diameter) and operating conditions (genarator temperature, condenser temperature, evaporator temperature and intercooler temperature, cooling capacity) was found. The rule is given in formula (3.1) with multivariable regression coefficients in table 3.3. In addition, the optimal area ratio of ejector was calculated to be 8.55 under experimental conditions (T_g = 80°C, T_c = 34°C, T_i = 15°C, T_e = 0°C), and independent of cooling capacity of the system.

4. An ejector numerical simulation model was performed by the ANSYS-FLUENT software. Simulation results on different ejectors show that: for R134a refrigerant working in the integrated cycle, the area ratio should be 8.88 and the length/ diameter of the throat should be 2.38 to 5.08.

5. An experimental system was built to test the theory as well as the possibility of integrating the ejector into compressor refrigeration system. Four ejectors with different area ratios were tested. Experimental results show that ejector EJ3 (area ratio of 8.46) gives the best results (entrainment ratio is higher than other ejectors under the same experimental conditions). The experimental results of the integrated system also show that the cascade cycle is capable of saving 21.7%-30.7% of electricity consumption compared to the corresponding compressor refrigeration cycle.

Advisor	**PhD student**
Prof. Dr Le Chi Hiep	**Nguyen Trung Kien**