天津商業大學
Tianjin University of Commerce

2014 Purdue Conferences
Compressor Engineering
Refrigeration and Air Conditioning
High Performance Buildings

Experimental Study on Performance of Two-throat Nozzle Ejector and Two-phase Ejector Refrigeration Cycle System

Liqian REN, Xianmin GUO *, Xinwei GUO, Tianlong LI

Tianjin Key Laboratory of Refrigeration Technology

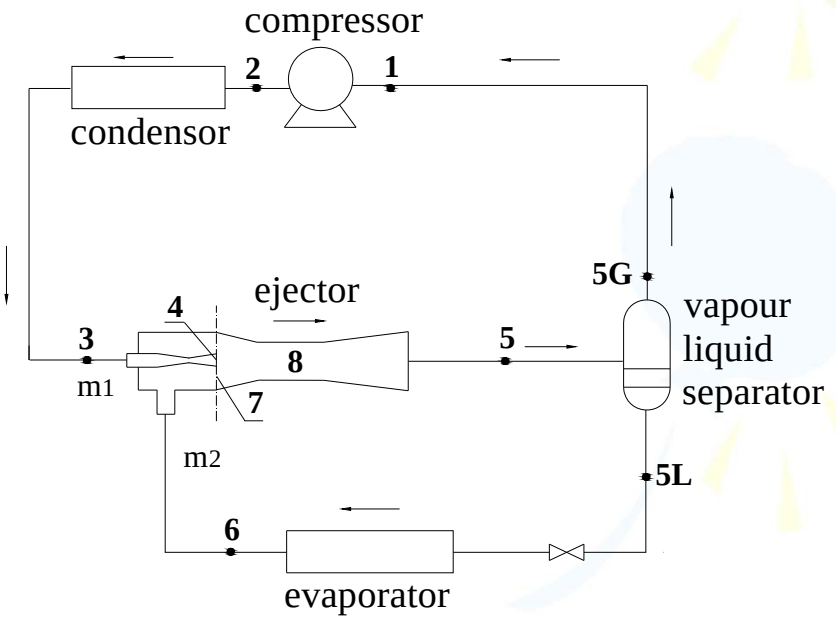
Tianjin University of Commerce

Tianjin, China

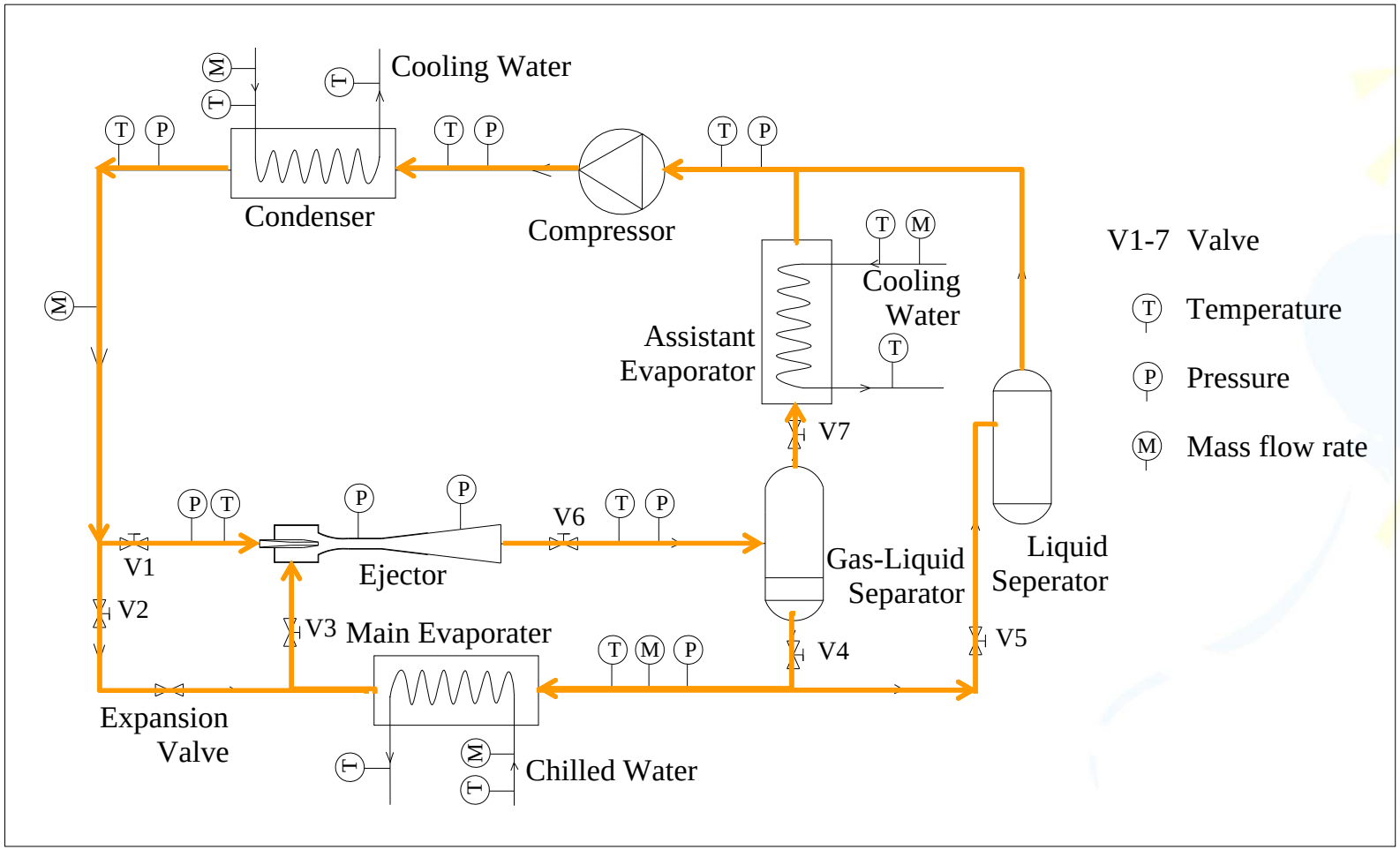
E-mail: xmguo@tjcu.edu.cn

1. INTRODUCTION

- **The expansion work in the refrigeration cycle can be recovered by using two methods. One is to replace the expansion valve with expander**
  - Wet expansion in the impeller
  - Reliability of the expander
- **Another is to use the ejector instead of expansion valve**
  - No moving components
  - High reliability
  - Simple structure

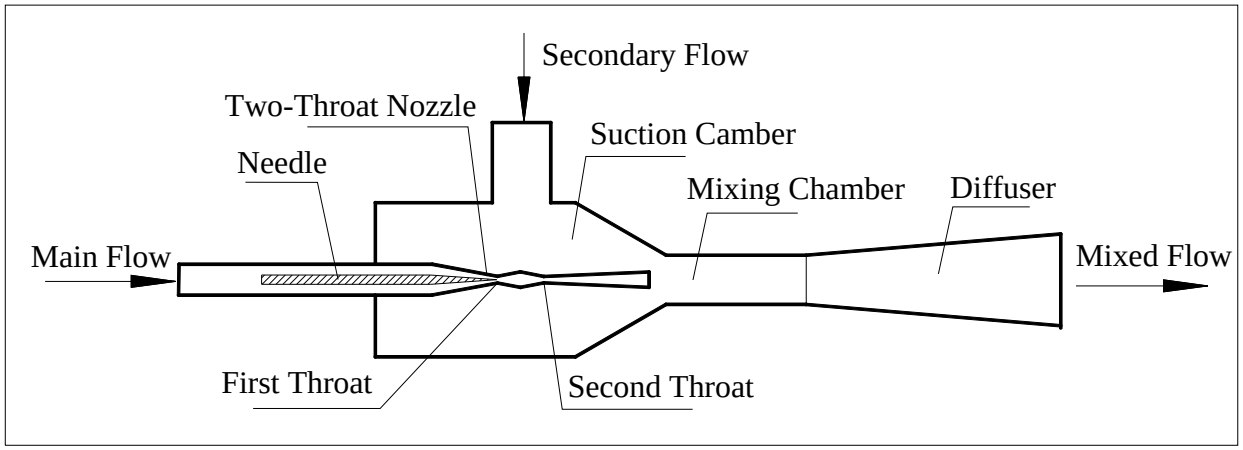


2 . EXPERIMENTAL SETUP



The Experimental Set-up

Prototype of two-throat nozzle ejector

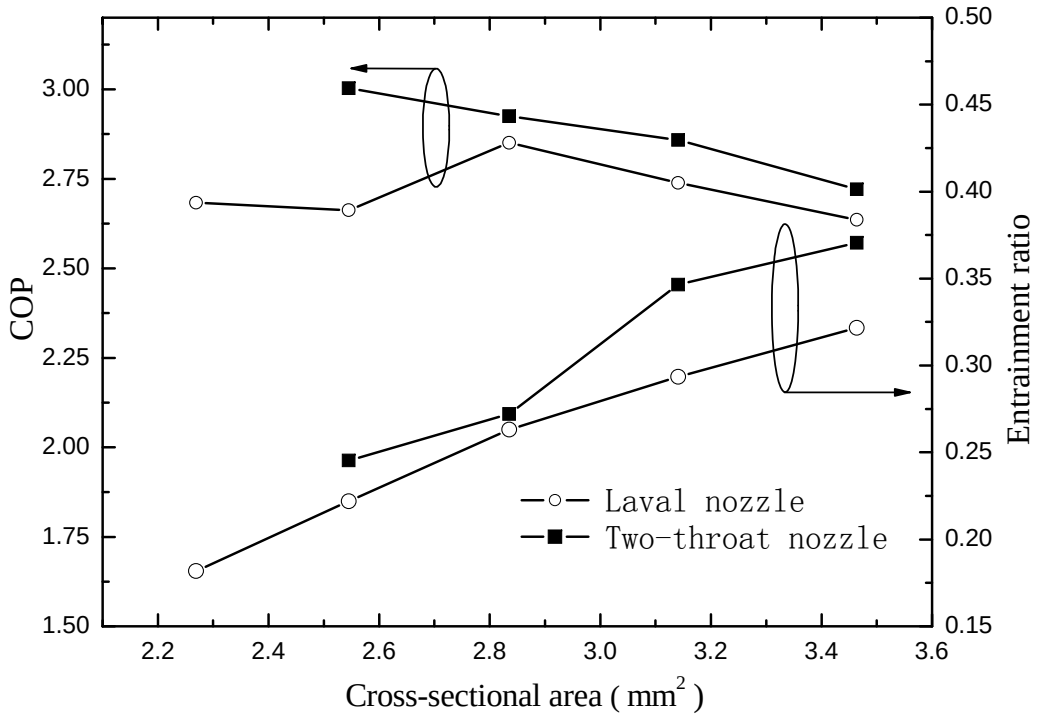


Cross-sectional throat area of experimental nozzles

Prototype Number		No.1	No.2	No.3	No.4	No.5
nozzle			2.55 mm^2	2.84 mm^2	3.14 mm^2	3.46 mm^2
Two-Throat Nozzle	**First Throat**	2.27 mm^2	2.55 mm^2	2.84 mm^2	3.14 mm^2	3.46 mm^2
	Second Throat	2.27 mm^2				

3. EXPERIMENTAL RESULTS AND ANALYSIS

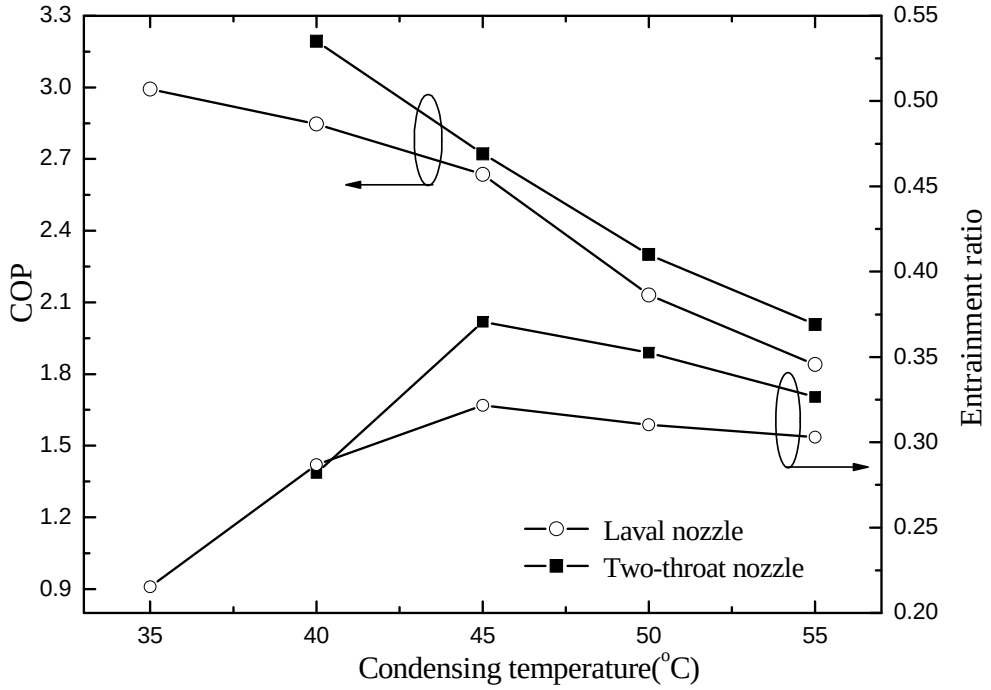
❖ Effect of Cross-Sectional Throat Area of Nozzle



- The entrainment ratio increases with the increase in the cross-sectional throat area, but the entrainment ratio of the two-throat nozzle ejector is greater than that of the Laval nozzle ejector , and the maximum increment of the entrainment ratio is about 18%.
- The COP of the TPERC system with two-throat nozzle ejector is greater than that of the TPERC system with the Laval nozzle ejector. The maximum increment of the system COP is about 12%.

3. EXPERIMENTAL RESULTS AND ANALYSIS

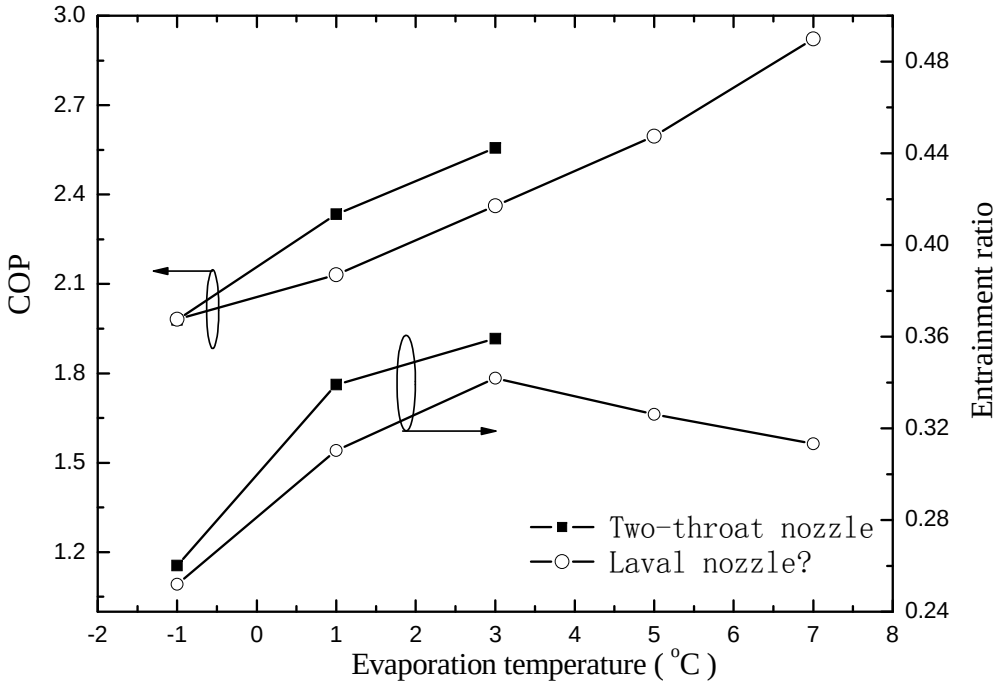
❖ Effect of Condensing Temperature



- The COP of the TPERC system with both the two types of nozzle ejector decreases with the increase in the condensing temperature.
- The entrainment ratio of both the two-throat nozzle ejector and the Laval nozzle ejector achieves the maximum value as the condensing temperature is 45℃

3. EXPERIMENTAL RESULTS AND ANALYSIS

❖ Effect of Evaporating Temperature



- The entrainment ratio of both the Laval nozzle ejector and the two-throat nozzle ejector achieves the maximum value as the evaporating temperature is 3℃ under the working condition of condensing temperature 50 ℃.
- The COP of the system with two types of ejectors increases with the increase in the evaporating temperature under the fixed condensing temperature.

4. CONCLUSIONS

- The entrainment ratio of the two-throat nozzle ejector with different geometric size is greater than that of the Laval nozzle ejector, the maximum increment of the entrainment ratio is about 18%. The COP of the TPERC system with the two-throat nozzle ejector is greater than that of the TPERC system with the Laval nozzle ejector, and the maximum increment of the system COP is about 12%.
- Under the working condition of the fixed evaporating temperature 1℃, the entrainment ratio of the two types of ejectors achieves the maximum as the condensing temperature is about 45℃, the entrainment ratio of the two-throat nozzle ejector increases by 15.2% compared to that of the Laval nozzle ejector.
- Under the working condition of the fixed condensing temperature 50℃, the entrainment ratio of the two-throat nozzle ejector achieves the maximum as the evaporating temperature is about 3℃ and increases by 5.1% compared to that of the Laval nozzle ejector.

Thank You for Your Attention!