THE BINARY FLUID EJECTOR REFRIGERATING SYSTEM FOR AIR CONDITIONING APPLICATION

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論 文 名　: THE BINARY FLUID EJECTOR REFRIGERATING SYSTEM FOR AIR
Title　　　　CONDITIONING APPLICATION
（空調への応用を目的としたバイナリー流体エジェクタ冷凍システムの研究）

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論 文 内 容 の 要 旨
Thesis Summary

Air conditioning is one of the most dynamic areas of refrigerating technologies while still remains high energy intensive.

Today, 90% of equipment for the purpose of climate control is vapor compression systems that consumes electricity. At the same time, the value of cold at this level of temperatures is very low. Specific exergy at 7°C equals to 0.082. Slightly higher 0.09 is an exergy of heat required for space heating. Thus, for cooling and heating purpose is no need to spend electricity or high-grade heat. In this case, it is appropriate to use affordable low-grade heat that means a widespread transition to heat utilizing thermotransformers. That fact substantiates the relevance and practical value of this work.

The choice of thermotransformers today is limited by sorption and jet systems, where the cycles of heat conversion to cold or anergy into heat are realized. Heat utilizing power supply systems application for heating or cooling is not reliable. A lot of attention was paid to sorption chillers or heat pumps, while jet pumps were, until recently, unclaimed. Recent studies have resolved the key problems of ejector systems that sharply increased interest to them. Promising in particular are binary fluid ejector refrigeration systems (BERS), the study of which is devoted by this work.

This thesis provides a comprehensive justification of the criteria for selecting a pairs for BERS, which form zeotropes. The effect of number of thermodynamic properties of components on entrainment ratio and COP is studied.

Conducted CFD research of binary fluid ejector led to a practical algorithm development for optimal ejector geometry calculation, that consists following steps: preliminary calculation and design based on empirical velocity coefficients, CFD modeling and sequential variation of dimensions to establish a steady flow without eddies and axial deviations of the jet, obtaining a maximum entrainment ratio, final

design and manufacturing.

Provided analysis of ejector operating in off-design conditions, defined compensation methods to maintain efficiency of the system by varying mass fractions and operating parameters.

Theoretical and experimental research of energy and exergy characteristics of BERS, defined optimal operating parameters for air-conditioning and refrigerating systems and combined schemas. Selected optimal pair of fluids R1233zde/Butane.

Provided results of tests of industrial thermovacuum drying systems designed by method described in this work. Developed schematic solution with application of ERS, EHP as binary and multicomponent systems that can be applied in various areas. Those solutions can be applied for construction materials production, heat rejection in gas of coal power stations, multiple services generation system, transport system, laundry and industrial drying, gas liquification, fire extinguishing systems etc.

This thesis provided analysis and conclusions on the following statements.

1. Selected and analyzed criteria of binary fluid pair selection for BERS.
2. Developed and tested approach of ejector operation compensation in off design conditions.
3. Based on exergy analysis obtained designed parameters for heating and cooling systems on primary and secondary heat;
4. Practical verification of CFD model of multiple ejectors was obtained.