Development of hydrophobic membrane-based compact absorption refrigeration system for automotive air-conditioning application

その他のタイトル	撥水性分離膜を用いた車載空調用小型吸収冷凍機に関する研究
学位授与年月日	2018-03-22
URL	http://doi.org/10.15083/00078489

論 文 の 内 容 の 要 旨

論文題目　Development of hydrophobic membrane-based compact absorption refrigeration system for automotive air-conditioning application

（撥水性分離膜を用いた車載空調用小型吸収冷凍機に関する研究）

氏　名　洪　成周

The number of automobiles are approximately a billion all over the world, and is projected to double by 2035. In general, automobile manufacturers have employed vapor compression refrigeration system to control the temperature, humidity, and air circulation within vehicles due to their small size and high performance-to-volume ratio. This compression system, however, has caused the significant problems, such that: a large energy consumption, and environmental problem such as the greenhouse effect, or ozone depletion. On the contrary, vapor absorption refrigeration system could be efficiently driven by the low-grade renewable heat associated with the exhaust gas from the car engine, and uses the eco-friendly refrigerant. The absorption cycle, however, has not yet obtained much attraction in the automobile application due to its large volume per unit of cooling capacity, weighty structure, and malfunction by harsh driving conditions, which has limited to use.

Micro-porous hydrophobic hollow fiber membrane based heat and mass exchangers are expected to be efficiently used for automotive absorption refrigeration system with influential advantages. To this purpose, theoretical mechanism of heat and mass transfer on the

hydrophobic hollow fiber membrane based heat and mass exchangers are introduced for the development of compact and lightweight absorption refrigeration system as an automotive application. This paper first describes the mechanism of the proposed membrane based heat and mass exchangers, and the system performance of the proposed cycle under various operating conditions is examined. The experimental work for the permeability of hollow fiber membrane is then shown to estimate the pore size of membrane which has an important role characterizing the mass transfer performance as well as to look into the gas permeation characteristic. Transient experiments demonstrates the characteristics of heat and mass transfer on the membrane based heat and mass exchangers for wide range of feed solution concentration under various practical operating conditions of absorption cycle. All the experimental heat and mass transfer are compared with theoretical simulation results to find the feasibility of the proposed application. Theoretical heat and mass transfer model evaluates the adiabatic desorption characteristics to maximize the mass transfer performance with respect to the dimension of the membrane based heat and mass exchangers.