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Experimental Study on Performance of Condenser of Two Different Types Used In Window Air Conditioner: A Review

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Abstract

This review paper presents the work of various researchers on the performance of condenser, used in air conditioners with various refrigerants. In this research author used different type of condenser, single and multi channel tubes. They determined various parameters like coefficient of performance (COP), cooling capacity, energy efficiency ratio (EER) of the system. Various approaches have been used by different authors to predict the performance of condenser in window air conditioner using alternative refrigerant as condenser devise. An air conditioning condenser is a vital part of an air conditioner responsible for cooling vapors coming from a compressor.

Keywords: Air conditioner, Condenser, Refrigerant R-22 & R-410A, COP.

Introduction

Air conditioning and refrigeration systems plays an important role in industry, infrastructure and households. The industrial sector includes the food industry, textiles, chemicals, printing, transport and others. Infrastructure includes banks, restaurants, schools, hotels and recreational facilities. Therefore, installation, repair and maintenance of equipment to function properly are important for the operations associated with those activities. An air conditioning condenser is a vital part of an air conditioner responsible for cooling vapors coming from a compressor. The air conditioning condenser is not only used in traditional air conditioners, but also refrigerators and almost any other type of device that delivers refrigerant or cooled air, to another location. The air conditioning condenser looks very much like a coil, or perhaps a radiator.

Heat exchanger with reliable and high performance has been the study focus of the refrigeration and air conditioning system. In recent years, with increasing demand for lightweight and rising copper prices, copper substitution is also a widespread concern. Under the premise of meeting the heat exchanger demand, multi-channel heat exchanger can reduce equipment weight, improve the device compactness. The manufacturing costs can be reduced and the product competitiveness can be improved by using aluminums. Along with the improving of process technology, multi-channel technology is gradually used in household air conditioning and automotive air conditioning system.

Fig.1 Single channel condenser

Fig.2 Multi channel condenser

Literature Review

This study investigates the effect of different type of condensers on the performance of R410A residential air conditioning systems was investigated. Two R410A residential air-conditioning systems, one with a micro channel condenser and the other with a round-tube condenser, were examined experimentally, while the other components of the two systems were identical except the condensers. The two systems were

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operated in separate environmental chambers and their performance was measured in various conditions. Both COP and cooling capacity of the system with the micro channel condenser were higher than those for the round-tube condenser in all test conditions. The refrigerant charge amount and the refrigerant pressure drop were measured; the results showed a reduction of charge and pressure drop in the micro channel condenser. A numerical model simulated the micro channel condenser with consideration given to the non-uniform air distribution at the face of the condenser and refrigerant distribution in the headers. The results showed that the effect of the air and refrigerant distribution was not a significant parameter in predicting the capacity of the micro channel condenser experimentally examined.[1]

This paper describes and analyzes a novel design of multiple parallel-pass (MPP) micro channel tube condenser and its applications to automotive A/C systems. A flow distributor concept is introduced in MPP condenser in order to enable parallel flow arrangement in adjacent flow paths. Throughout analysis of two-phase flow and heat transfer processes in MPP condenser, a two-phase zone enlargement technique is developed to enhance condensation heat transfer and reduce pressure drop. Performance test results show MPP condenser is able to improve heat transfer rate as high as 9.5% while its refrigerant mass flow increases 13.34% when comparing to a benchmark PF condenser. [2]

This paper presents experimental results from a prototype ammonia chiller with an air-cooled

Condenser and a plate evaporator. The main objectives were charge reduction and compactness of the system. The charge is reduced to 20 g/kW (2.5 oz/Ton). Two aluminum condensers were evaluated in the chiller: one with a parallel tube arrangement between headers and ‘‘micro channel’’ tubes (hydraulic diameter Dh ¼ 0.7 mm), and the other with a single serpentine ‘‘macro channel’’ tube (Dh ¼ 4.06 mm). The performances of the chiller and condensers are compared based on various criteria to other available ammonia chillers. [3]

This paper presents an experimental investigation of three liquid vapor separation condensers (LSC) were tested to evaluate their ability to automatically separate the liquid and vapor during condensation. The performance of the LSC system having the greatest cooling capacity and energy efficiency ratio (EER) was then compared with that of the system having a baseline fin-and-tube condenser for various ambient temperatures. The results showed that both the cooling capacity and EER of the two systems were almost the same, with the LSC having just 67% of the heat transfer area of the baseline condenser. In addition, the LSC system was charged with only 80% of the refrigerant in the baseline system. [4]

The objective of this study is to present test results of a fin and tube condenser was performed using two different configurations of condenser paths (U and Z type) and two kinds of refrigerants (R-22 and R-407C) as working fluids. An integral test facility was constructed to evaluate the heat transfer capacity of the air and refrigerant sides of the condenser. Different condenser capacities were obtained from both the experimental and numerical results, depending on the paths and refrigerants used. R-22 performed better than R-407C for the Z-type path configuration, but no significant difference was found between results using either refrigerant in the U-type path configuration. On average, the numerical results obtained with R-22 were 10.1% greater than experiment data; using R-407C, results were 10.7% less than experiment data. The numerical code can be used as a design tool to develop better condenser paths. [5]

In this paper the thermal-hydraulic performance of micro channel condensers with open-cell metal foams to enhance the air-side heat transfer is investigated. Three different copper metal foam structures with distinct pore densities (10 and 20 PPI) and porosities (0.893 and 0.947) were tested. A conventional condenser surface, with copper plain fins, was also tested for performance comparison purposes.. The experiments were performed at a condensing temperature of 45 C. The air-side flow rate ranged from 1.4 X 10 X 3 to 3.3 X 10 X 3 m3/s (giving face velocities in the range of 2.1e4.9 m/s). The heat transfer rate, the overall thermal conductance, power were calculated as part of the analysis.[6]

This paper focuses on an investigation of reduction of energy consumption is a major concern in the vapor compression refrigeration cycle especially in the area with very hot weather conditions (about 50 C), where window-air-conditioners are usually used to cool homes.. In this article, a new design with high commercialization potential for incorporating of evaporative cooling in the condenser of window-air-conditioner is introduced and experimentally investigated. A real air conditioner is used to test the innovation by putting two cooling pads in both sides of the air conditioner and injecting water on them in order to cool down the air before it passing over the condenser. The experimental results show that thermodynamic characteristics of new system are considerably improved and power consumption decreases by about 16% and the coefficient of performance increases by about 55%.[7]

In this paper the better improvement on the system performance of R-410A inverter air conditioner was performed. The proper operating strategies of whole system with evaporative cooling unit were investigated experimentally and numerically. The adapting system

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was tested by varying of frequency, water flow rate and spraying temperature. The water injection rate of 200 l/h obtains the best COP at a low frequency range while the flow rate of 100 l/h being at a high frequency range. Finally, the integrated model and the leakage inventory model were developed to predict the performance and the optimal charge, respectively.[7]

Conclusion

The above literature review presents that in recent years, micro-channel heat exchanger has been more widely applied in the refrigeration and air conditioning industry. Micro channel heat exchangers are made from aluminum. These features make micro channel designs appropriate for use in the automobile industry.The proper refrigerant charge in an air conditioner is an important subject in the system design. Hence, the optimum refrigerant charge was investigated for proper cooling at standard conditions. Micro channel tubes offer charge reductions over conventional round tube heat exchangers.

Micro channel condenser improves COP, condenser capacity, and evaporator capacity, compared to the conventional round-tube condenser.

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