REVIEW PAPER ON REFRIGERATION SYSTEM USING MICROCHANNEL CONDENSER

[1]Deepak P.Patil , [2]Krushna S. Deshmukh

[1]PG Student, Mech. Dept., MCERC, Nasik (India)
[2]UG Student, Mech. Dept., MCERC, Nasik (India)

ABSTRACT-

Micro channel condenser now days can be effectively used due to its compact size in automobile sector. In this paper review of microchannel condensers can be condenser can be found to be more at various loads and operating conditions. For review same size of microchannel and round tube condenser are considered. From considered and compared with round tube condenser. From the previous experiments the micro-channel condenser was made to have nearly an identical face area, depth and fin density as the round-tube condenser which was the baseline. Also varying the refrigerants, C.O.P & Efficiency of micro channel the various reviews of reviewer micro channel condenser can be efficient and also refrigerator system requires less power.

Key Words - ***Micro Channel Condenser, Round Tube Condenser, COP, Efficiency, Refrigeration, Area***

I.INTRODUCTION

The purpose of this review is to experimentally estimate improved condenser and evaporator capacity and system COP by replacing a round-tube condenser with a micro channel condenser having almost identical frontal area and depth, without considering heat exchanger cost. The baseline (round tube) condenser along with all other elements of the system was part of a carefully sized air-conditioning system. With the advent of refrigeration, interest in condensation has increased since a condenser is one of the main components of the basic vapor-compression refrigeration. Fig.(1) shows a schematic of a full microchannel condenser. The tubes are brazed to the headers with louvered fins in between. The refrigerant is circuited using baffles inside the headers, involving more than one tube in each pass. This reduces the total pressure drop of the condenser due to fewer passes. These heat exchangers provide the same amount of heat transfer with a much lower refrigerant charge (about 2/3 that of a serpentine condenser) than condensers now commonly used in the industry. This attribute is very beneficial to car manufacturers as any reduction in the space. Also, a smaller charge requirement translates into a lower cost for installation and less of a threat to the environment should the system ever leak.

Now, days while considering the global environment it is necessary to overcome ozone depletion, greenhouse effect, and other problems associated with the current state of technology; research in refrigeration has grown even more. Now, research focuses on determining the properties and effects of using alternative, non chlorofluorocarbon (CFC) refrigerants such as 1, 1, 1, 2-tetrafluoroethane (R-134a) as replacements for the commonly used CFC's.

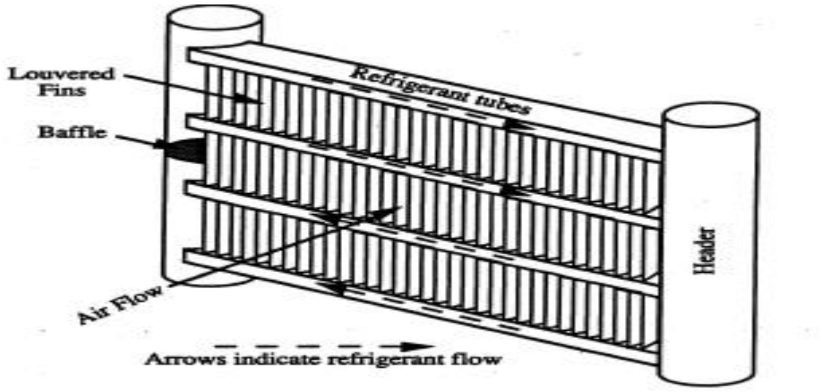

Fig.1 Microchannel condenser

Time is being wisely spent on new refrigeration component technology in order to protect our finite environment. This project will follow suit by using ozone-safe R-134a and R-190a as its working fluid. The future use of the micro channel condenser technology is predicted to increase substantially over the next decade. The new government rules relate to refrigeration system can be easily followed if micro channel condenser with R134a and R190a can be used as a refrigerant.

II.LITERATURE REVIEW

The literature review in carried out in order to see the present research in this area which is elaborated under the present status. Further review will be carried out for the following purpose by referring journals like International Journal Of Refrigeration, Applied Thermal Engineering, ASHRAE Journal, Renewable and Sustainable Energy Review, Journal of Industrial and Scientific Research etc.

Many researchers have attempted experimental and theoretical work on micro channel condenser some of this work is focused on the use of micro channel condensers in Refrigeration System.

1. Qian Sub, Guang Xu Yua, Hua Sheng Wanga,, John W. Rosea, [1] reported short communication on Microchannel condensation : Correlations and theory Attention is drawn, to the fact that, while four different correlations for condensation in Micro channels are in fair agreement for the case of R134a (on which the empirical constants in the correlations are predominately based) they differ markedly when applied to other fluids such as ammonia. A wholly theoretical model is compared with the correlations for both R134a and ammonia.

2. Liang-Liang Shaoa, Liang Yanga,b, Chun-Lu Zhangb,, Bo Gua[2] presented Numerical modeling of serpentine microchannel condensers. Microchannel (or mini-channel) heat exchangers are drawing more attention because of the potential cost reduction and the lower refrigerant charge. Serpentine microchannel heat exchangers are even more compact because of the minimized headers. Using the serpentine microchannel condenser, some thermodynamically good but flammable refrigerants like R-290 (Propane) can be extended to more applications. To well size the serpentine microchannel condensers, a distributed-parameter model has been developed in this paper. Airside maldistribution is taken into account. Model validation shows good agreement with the experimental data. The predictions on the heating capacity and the pressure drop fall into 10% error band. Further analysis shows the impact of the pass number and the airside maldistribution on the condenser performance.

3. Gunda Mader, Georg P.F. Fosel, Lars F.S. Larsen [3] Presented Comparison of the transient behavior of microchannel and fin-and-tube evaporators. The development of control algorithms for refrigeration systems requires models capable of simulating transient behavior with sensible computational time and effort. The most pronounced dynamics in these systems are found in the condenser and the evaporator, especially the transient behavior of the evaporator is of great importance when designing and tuning controllers for refrigeration systems. Various so called moving boundary models were developed for capturing these dynamics and showed to cover the important characteristics. A factor that has significant influence on the time constant and nonlinear behavior of a system is the amount of refrigerant charge in the evaporator which is considerably reduced when microchannel heat exchangers are utilized. Here a moving boundary model is used and adapted to simulate and compare the transient behavior of a microchannel evaporator with a fin-and-tube evaporator for a residential air-conditioning system. The results are validated experimentally at a test rig.

4. J.R. Garcı´a-Cascales, F. Vera-Garcı´a, J. Gonza´lvez-Macia, J.M. Corbera´n-Salvador,M.W. Johnson,G.T. Kohler [4] Presented Compact heat exchangers modeling: Condensation a model for the analysis of compact heat exchangers working as either evaporators or condensers is presented. This paper will focus exclusively on condensation modeling. The model is based on cell discretization of the heat exchanger in such a way that cells are analyzed following the path imposed by the refrigerant flowing through the tubes. It has been implemented in a robust code developed for assisting with the design of compact heat exchangers and refrigeration systems. These heat exchangers consist of serpentine fins that are brazed to multi-port tubes with internal microchannels. This paper also investigates a number of correlations used for the calculation of the refrigerant side heat transfer coefficient. They are evaluated comparing the predicted data with the experimental data. The working fluids used in the experiments are R134a and R410A, and the secondary fluid is air. The experimental facility is briefly described and some conclusions are finally drawn.

5. Pega Hrnjak*,1, Andy D. Litch [5] Reported Microchannel heat exchangers for charge minimization in air-cooled ammonia condensers and chillers 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). This is lower than any currently available air-cooled ammonia chiller on the market. The major contribution comes from use of microchannel aluminum tubes. Two aluminum condensers were evaluated in the chiller: one with a parallel tube arrangement between headers and ‘‘microchannel’’ tubes (hydraulic diameter Dh ¼ 0.7 mm), and the other with a single serpentine ‘‘macrochannel’’ tube (Dh ¼ 4.06 mm). The performances of the chiller and condensers are compared based on various criteria to other available ammonia chillers. This prototype was made and examined in the Air Conditioning and Refrigeration Center in 1998, at the University of Illinois at Urbana-Champaign.

6. Akhil Agarwal a, Todd M. Bandhauer b, Srinivas Garimella b,*[6] Reported Measurement and modeling of condensation heat transfer in non-circular microchannels heat transfer coefficients in six non-circular horizontal microchannels (0.424 < Dh < 0.839 mm) of different shapes during condensation of refrigerant R134a over the mass flux range 150 < G < 750 kg m_2 s_1 were measured in this study. The channels included barrel-shaped, N-shaped, rectangular, square, and triangular extruded tubes, and a channel with a W-shaped corrugated insert that yielded triangular microchannels. The thermal amplification technique developed and reported in earlier work by the authors is used to measure the heat transfer coefficients across the vapor-liquid dome in small increments of vapor quality. Results from previous work by the authors on condensation flow mechanisms in microchannel geometries were used to interpret the results based on the applicable flow regimes. The effect of tube shape was also considered in deciding the applicable flow regime. A modified version of the annular-flow-based heat transfer model proposed recently by the authors for circular microchannels, with the required shear stress being calculated from a non-circular microchannel pressure drop model also reported earlier was found to best correlate the present data for square, rectangular and barrel shaped microchannels. For the other microchannel shapes with sharp acute-angle corners, a mist-flow-based model from the literature on larger tubes was found to suffice for the prediction of the heat transfer data. These models predict the data significantly better than the other available correlations in the literature.

7. G.B. Ribeiro, J.R. Barbosa Jr., A.T. Prata [7] Presented Performance of microchannel condensers with metal foams on the air-side: Application in small-scale refrigeration systems. The thermal-hydraulic performance of microchannel condensers with open-cell metal foams to enhance the air-side heat transfer is investigated in this paper. 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 experimental apparatus consisted of a closed-loop wind tunnel calorimeter and a refrigerant loop, which allowed the specification of the mass flow rate and thermodynamic state of R-600a at the condenser inlet. The experiments were performed at a condensing temperature of 45 _C. The air-side flow rate ranged from 1.4 _ 10_3 to 3.3 _ 10_3 m3/s (giving face velocities in the range of 2.1e4.9 m/s). The heat transfer rate, the overall thermal conductance, the Colburn j-factor, the friction factor and the pumping power were calculated as part of the analysis.

8. ZHANG Huiyong, LI Junming , LI Hongqi [8] Presented Numerical Simulations of a Micro-Channel Wall-Tube Condenser for Domestic Refrigerators in recent years, microchannel heat exchangers have begun to be used in refrigeration and air conditioning systems. This paper introduces a microchannel condenser for domestic refrigerators with a theoretical model to evaluate its performance. The model was used to obtain the optimal design parameters for different numbers of tubes and tube lengths. The results show that the needed tube height of the downward section decreases with the number of tubes and the tube diameter. Compared with the original condenser, the present optimal design parameters can reduce the total metal mass by 48.6% for the two wall two side design and by 26% for the two wall one side design. Thus, the present condenser is much better than the condensers usually used in actual domestic refrigerators.

9. D. A. Luhrs and W. E. Dunn [9] Presented Design and Construction of a Microchannel Condenser Tube Experimental Facility. A test facility was built for the purpose of performing heat transfer studies on microchannel heat exchangers. The studies will involve condensation of refrigerant 134a inside the enhanced tubes,' although no condensation results are presented in this document. The design and construction of the experimental facility is detailed with a description of each component and its function in the stand. The operation of the facility was verified using an energy balance analysis and the results are presented. The refrigerant and air side heat transfers agree within ±3% at high air flow rates but fall out of this error bound at lower flow rates. Also, a discussion of the method for determining the refrigerant and air side resistances for the tube is given along with the theory for future correlation development. Finally, future modifications to the stand are suggested in order to correct any problems with it, improving the ability of the stand to produce accurate, reliable heat transfer performance data.

III.SPECIFICATIONS OF VARIOUS CONDENSERS FROM REVIEWS

TABLE 1
Dimensions of Microchannel condenser
Ref. from International journal of refrigeration 36 (2013) 173e190

Face area(cm^2)	5939	Refrigerant side Area (m^2)	3.7
Airside area(m^2)	16.51	Tubes number	66
Tube length (mm)	889	Refrigerant passes	2
Fin type	Louvered	Tube depth (mm)	19
Number of ports	19	Fin Depth (mm)	21.5
Wall thickness(mm)	0.32	Fin density(fins/in)	14
Fin thickness (mm)	0.11	Fin height (mm)	8.1

TABLE 2
Ref. From International journal of refrigeration 31 (2008) 822-831

Dimension	Microchannel condenser	Round tube condenser
Face area (m^2)	1.32	1.43
Depth (m)	0.021	0.0191
Volume (m^3)	0.0277	0.0273
Are side area (m^2)	46.06	45.04
Tube O.D (mm)	1.9*21	9.5

IV.CONCLUDING REMARKS

1. Heat Transfer Rates In Refrigeration System Can Be Improved By Different Techniques Like Internal Microfins,Wireinsert And Microchannel condensers etc.
2. Internal microfins manufacturing is comparatively difficult that microchannel condensers.
3. Cost reduction initial and Running Cost of the System.

V. OBJECTIVE OF THE REVIEWS

1. To Reduce The System Refrigerant Charge.
2. To Develop More Compact System.
3. To Find The Coefficient Of Performance Of Square Port Type Microchannel Condenser Using R134a As A Refrigerant.
4. To Study The Heat Rejection in Square Port Type Microchannel Condenser.

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