International Journal of Recent Engineering Science (IJRES),
ISSN: 2349-7157, *Volume2 Issue 1January to February 2018*

Performance Improvement by Internal Heat Exchanger in R134a Mobile Air Conditioning System

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Abstract
The global warming danger requires new technologies to minimize depletion ozone layer. The ozone layer protects earth from various harmful radiations to enter on earth. In Mobile Air Conditioning (MAC) systems the major contributing factor of ozone depletion is refrigerant. The rate of increase of number of automobiles is tremendous every year which cumulatively increase ozone depletion. To improve the Mobile Air Conditioning system performance and reduce the effect on environment, R134 refrigerant with addition of internal heat exchanger and thermal expansion valve can be experimented .Internal heat exchanger is in the form of micro channel tube with heat transfer enhancement characteristics. Moderate and severe Conditions show improvement of 10-12% increase in cooling capacity performance as compared to baseline condition.

Keywords – *Internal Hea t Exchanger, MAC, R134a, Refrigerent,COP*

I. INTRODUCTION

The Current Study is focused on optimizing and improving the performance of HVAC with refrigerant R134a for MAC (Mobile Air conditioning) system. Various group have studied about the intrinsic and extrinsic properties of R134a to understand the behavior and performance gap with proposed refrigerant to meet the GWP, Few group tried to breach the gap of performance with various technologies of compressor. We tried to optimize the system performance of R134a with internal heat exchanger (IHX) at various test conditions. This involves minimum system level changes. The cooling capacity and system COP is higher with R134a in mobile air conditioning with IHX and with IHX and thermal expansion valve (TXV). To meet the global climate change and energy are the major concern to MAC industries with almost equivalent or better performance than R134a. The details of the same are discussed under the results.

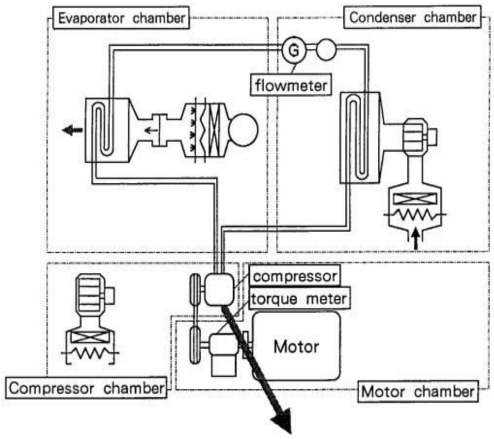

Fig.1 Experimental set up

II. EFFECT OF INTERNAL HEAT EXCHANGER

To better understand the cycle changes with an IHX, following characteristics cycle should be noted.
The specific volume at the compressor inlet increases as evaporating pressure decreases (valve closes)
This is due to a decrease in evaporating pressure that is partially counterbalanced by a decrease in suction line pressure drop and a decrease in IHX heat transfer. Since the compressor has a fixed volumetric displacement The evaporator inlet specific enthalpy decreases and outlet specific enthalpy increases, increasing the specific capacity of the evaporator The overall cooling capacity of the system is a product of mass flow rate and specific enthalpy change. With all sets of inlet condition (mass flow rate, thermodynamic state, and refrigerant properties) the outlet conditions are functions of only these variables. One parameter to set is the pressure drop. For the systems discussed, high side pressure drop is usually negligible. The IHX model confirms this assumption. This is due to the high side containing sub cooled liquid and the associated high (relative to the low side) heat transfer. This allows a simple geometry (round tube in this case) that has sufficient heat transfer characteristics and low pressure drop.

III. EXPERIMENTAL RESULTS

The Set up comprises of three chambers. These are Evaporator, Compressor and Condenser

Chambers. The entire three chambers can be setup to different range of humidity and temperature. The test conditions are decided based on the vehicle road conditions and doing benchmark from different system level test bench e.g. JAMA test conditions. The range of humidity is 30% to 75% and Temperature -10°C to +55°C. The pulley ratio is set according to the vehicle engine to compressor pulley ratio.Two test condition studied are as follows:

1. Severe test condition, performed at 45°C/40% at condenser and evaporator chamber and compressor (Scroll type) at 100 °C.
2. Moderate test condition, performed at 35°C/40% at condenser and evaporator chamber and compressor (Scroll type) at 70 °C.

Compressor	Fixed displacement
Capacity (CC)	90
Condenser	Multi-flow
Size (mm)	360 X 500 X 16
Evaporator	Multi-flow
Size (mm)	230 x 210 x 55
Expansion valve Capacity	1.5 ton
Refrigerant charge	(800 g)

Table No.01 Test system specification

IV. FIGURES AND TABLE

The test results are as per given below

Test Condition		Moderate	Severe
R134a (baseline)	Cooling Capacity (kilowatt)	4.95	4.05
	Power Consumption (kilowatt)	2.05	2.5
	Coefficient Of Performance	2.41	1.62
R134a + IHX	Cooling Capacity (kilowatt)	5.15	3.95
	Power Consumption (kilowatt)	2.0	2.4
	Coefficient Of Performance	2.57	1.65
Test Condition		Moderate	Severe
R134a + IHX + New TXV	Cooling Capacity (kilowatt)	5.3	4.15
	Power Consumption (kilowatt)	2.0	2.4
	Coefficient Of Performance	2.7	1.73

Table No.02 Test condition

V. CONCLUSION

Both the conditions moderate and severe show improvement of cooling capacity performance of R134a with IHX. Moderate and severe Conditions show improvement of 6-12% increase in cooling capacity performance with IHX and TXV as compared to baseline condition. Further study is required to optimize the system and achieve the performance with new refrigerants.

ACKNOWLEDGMENT

The authors wish to thanks Dr. Y. P.Reddy and Mr.D.M. Mani, for their valuable guidance and his support for throughout this work without which the successful completion would be quite difficult.

REFERENCES

[1] S. M. Nelson and P.S. Hrnjak, (2002), 'Improved R134a mobile air conditioning system', University of IIlinois , 2002, pp. 1-291.

[2] Park Y. C., Mc Enaney, R. Boewe, Yin J.M. Hrnjak (2008), 'Steady state and cyclic performance of a typical R134a mobile A/c system', SAE International congress and Expository, 1999, pp. 01-190.

BOOKS

[1] 'ASHRAE Handbook system and equipment'(2000), American society of heating, refrigeration and air-conditioning Engineer, 2000,