iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** IV **Month of publication:** April 2017

DOI: http://doi.org/10.22214/ijraset.2017.4222

Volume 5 Issue IV, April 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Enhancement of COP by using Liquid Line-Suction Line Heat Exchanger at Various Lengths with Refrigerant R-134a

Ms. Priyanka V. Desai [1], Mr. Umang M. Satute [2], Mr. Suraj N. Salunke [3], Mr. Rushikesh A. Taware [4], Mr. Akshay B. Ransing [5]
Trinity Academy of Engineering, Mechanical Department, Savitribai Phule Pune University

Abstract: Improvement of performance of system is very much important for higher refrigerating effect or reduced power consumption for same refrigerating effect. By sub-cooling using heat exchanger at condenser inlet refrigerating effect increases and power consumption or work input decreases.
The temperature of the vapor refrigerant coming out from the evaporator is less than the temperature of the liquid coming out from the condenser. Before the expansion process, heat is transferred from the liquid line to the suction line. As a consequence this in turn reduces the refrigerant quality at the inlet of the evaporator and therefore increases the refrigerating capacity. The main objective of this project is to evaluate the performance of refrigerator with liquid line suction line heat exchanger for different lengths of heat exchanger by using R134a as refrigerant and compare with different lengths of liquid line- suction line heat exchanger. And thus COP of VCR system improved which results in reduced consumption of energy.
Keywords: liquid line- suction line heat exchanger, R134a, COP, VCR, refrigerant quality

I. INTRODUCTION

In existing VCR system the COP is 2.121 which is lower and the power consumption is comparatively higher which results in excess energy consumption. The use of heat exchanger have the potential to increase COP of VCR system higher than 2.289.

In vapor compression refrigerating system basically there are two heat exchangers. One is to absorb the heat which is done by evaporator and another is to remove heat absorbed by refrigerant in the evaporator and the heat of compression added in the compressor and condenses it back to liquid which is done by condenser.

Domestic refrigerator selected for the project has the following specifications:

Capacity of The Refrigerator: 200 liters

Refrigerant used: R-134a

Compressor capacity: 0.16 H.P.

R134a is the more environment friendly than other existing available refrigerants.

Coefficient of performance is increased for different lengths of liquid line-suction line heat exchanger and at the length of heat exchanger of 30 cm for R134a is 2.211. Heat to be rejected in condenser is increased for different lengths of liquid line-suction line heat exchanger and at the length of heat exchanger of 30 cm is high for R134a is 301.74 perTR.

Liquid-suction heat exchangers are effective in:

Increasing the system performance

Fully evaporating any residual liquid that may remain in the liquid-suction prior to reaching the compressor

The observations are considered for the existing system as well as 30cm, 40cm 50cm & 60cm of the heat exchanger

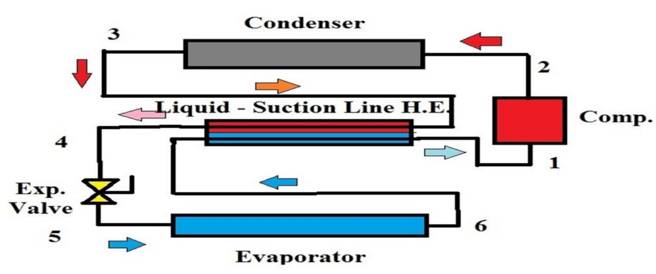


Fig.1 layout of liquid line suction line heat exchanger

Volume 5 Issue IV, April 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

II. CALCULATION OF PERFORMANCE PARAMETERS

A. Net Refrigerating Effect (NRE)(kJ/kg) = h1-h4
B. Mass flow rate to obtain one TR, kg/min. Mr= 210/NRE
C. Work of Compression (kJ/kg) = h2-h1
D. Heat Equivalent of work of compression per TR (kJ/min) Mr x (h2-h1)
E. Theoretical power of compressor (kW) = Heat Equivalent of work of compression per TR /60
F. Coefficient of Performance (COP) = h1-h4 / h2-h1
G. Heat to be rejected in condenser (kJ/kg) = h2-h3
H. Heat Rejection per TR (kJ/min) = (210/NRE) x (h2-h3)
I. Heat Rejection Ratio = Heat Rejection per TR /210
J. Compression Pressure Ratio = $\boldsymbol{DishcargePressure} / \boldsymbol{SuctionPressure} = \boldsymbol{Pd}/\boldsymbol{Ps}$

The temperature, pressure and enthalpy at state points for the system using R134a by adopting heat exchanger with different lengths is shown in following table.

TABLE I
Temperature, Pressure and enthalpy readings at state points using R134a with and without heat exchanger

Sr. No.	content	Length of Heat Exchanger				
	Parameters	Exist	30	40	50	60
1.	Compressor Discharge Temperature T2(°C)	70	70	70	70	70
2.	Condensing Temperature T3(°C)	42	40	38.8	35.8	35
3.	Evaporator Temperature T4(°C)	-18	-18.4	-18.5	-18.8	-19
4.	Compressor suction pressure P1(bar)	1.03	1.03	1.03	1.03	1.03
5.	Compressor discharge pressure P2(bar)	12.65	12.65	12.65	12.65	12.65
6.	Condenser pressure P3 (bar)	12.65	12.65	12.65	12.65	12.65
7.	Evaporator pressure P4(bar)	1.03	1.03	1.03	1.03	1.03
8.	Enthalpy,h1 (kJ/kg) (Comp. Suction)	387.65	387.32	387.24	386.99	386.82
9.	Enthalpy,h2 (kJ/kg) (Comp. Outlet)	447.44	447.44	447.44	447.44	447.44
10.	Enthalpy,h3 (kJ/kg) (condenser outlet)	259.33	256.34	254.58	250.19	249.02
11.	Enthalpy,h4 (kJ/kg) (evaporator inlet)	260.83	254.39	252.09	249.76	248.06

TABLE III
Performance parameters using R134a with and without heat exchanger

Sr.	Parameters	Heat Exchanger Length				
		Exist	30	40	50	60
1.	(COP)	2.121	2.211	2.245	2.270	2.289
2.	Net refrigerating effect , kJ/kg	126.82	132.93	130.14	137.23	138.76
3.	Work of Compression, kJ/kg	59.79	60.12	60.2	60.45	60.62
4.	Compressor Power, kW	1.64	1.58	1.55	1.54	1.52
5.	Mass flow rate to obtain one TR, kg/min	1.65	1.57	1.55	1.53	1.51
6.	Heat Equivalent work of compression per TR, kJ/kg	98.65	94.92	93.31	92.48	91.71
7.	Heat rejected in condenser , kJ/kg	188.11	191.1	192.86	197.2	198.42
8.	Heat Rejection per TR, kJ/min	310.38	301.74	298.93	301.71	300.20
9.	Heat Rejection Ratio	1.47	1.43	1.42	1.43	1.42
10.	Compression Pressure Ratio	12.37	12.37	12.37	12.37	12.37

Volume 5 Issue IV, April 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

III. RESULTS

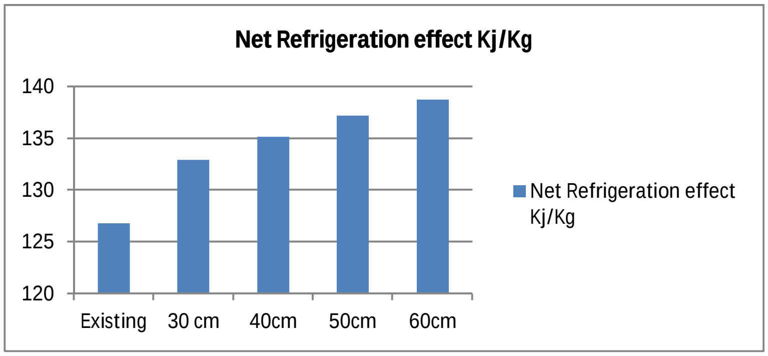


Chart 1: Effect of Heat exchanger length and different refrigerants on Net Refrigerating effect

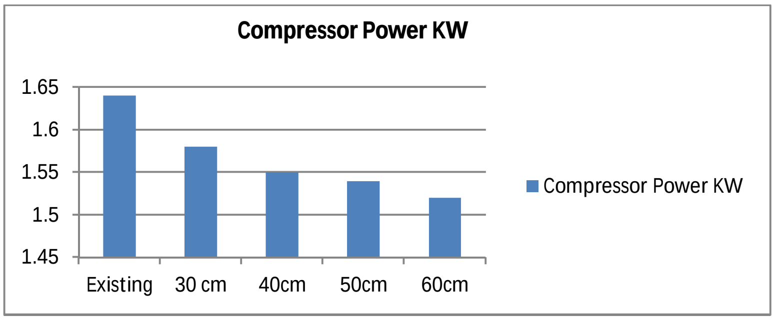


Chart 2: Effect of Heat exchanger length and different refrigerants on compressor power

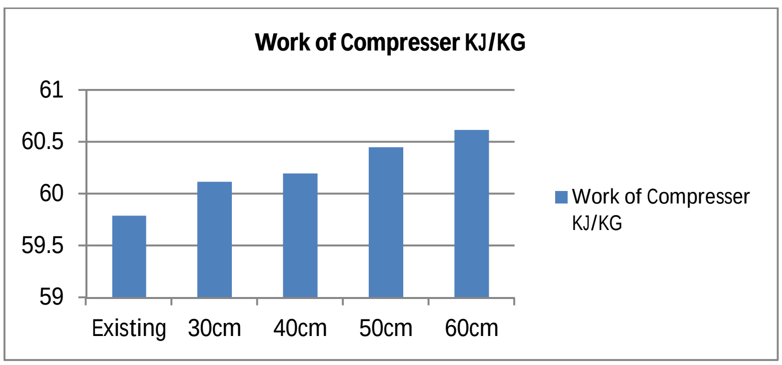


Chart 3: Effect of Heat exchanger length and different refrigerants on compression work

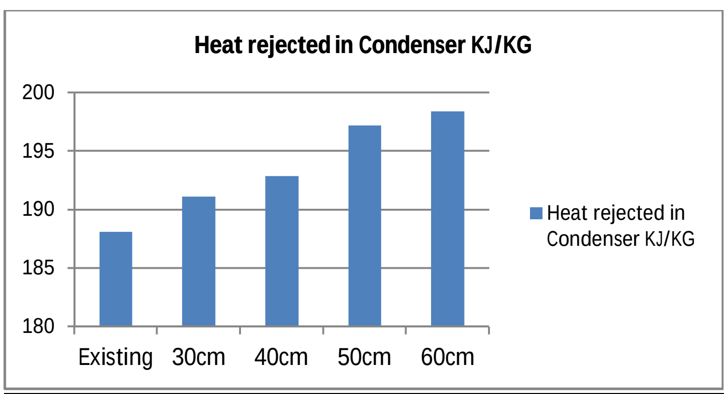


Chart 4: Effect of Heat exchanger length and different refrigerants on Heat rejected

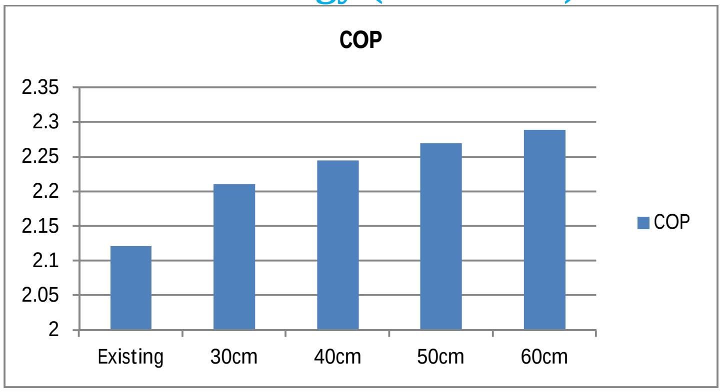


Chart 5: Effect of Heat exchanger length and different refrigerants on COP

IV. CONCLUSIONS

COP increases up to 7.9% using liquid line suction line heat exchanger of 60 cm. Net refrigeration effect increased by 8.60%, Compressor power also decreased by 7.31% Hence it is useful to use heat exchanger in Vapor compression refrigeration. If length of heat exchanger increased then heat rejection rate perTR decreased, and the cooling effect obtained is increased.

REFERENCES

[1] "Experimental analysis of vapor compression refrigeration system with liquid line suction line heat exchanger by using r134a and r404a" G. MaruthiPrasadYadav, P. RajendraPrasad, G.Veeresh. International Journal of Scientific Research and Management Studies (IJSRMS) ISSN: 23493771

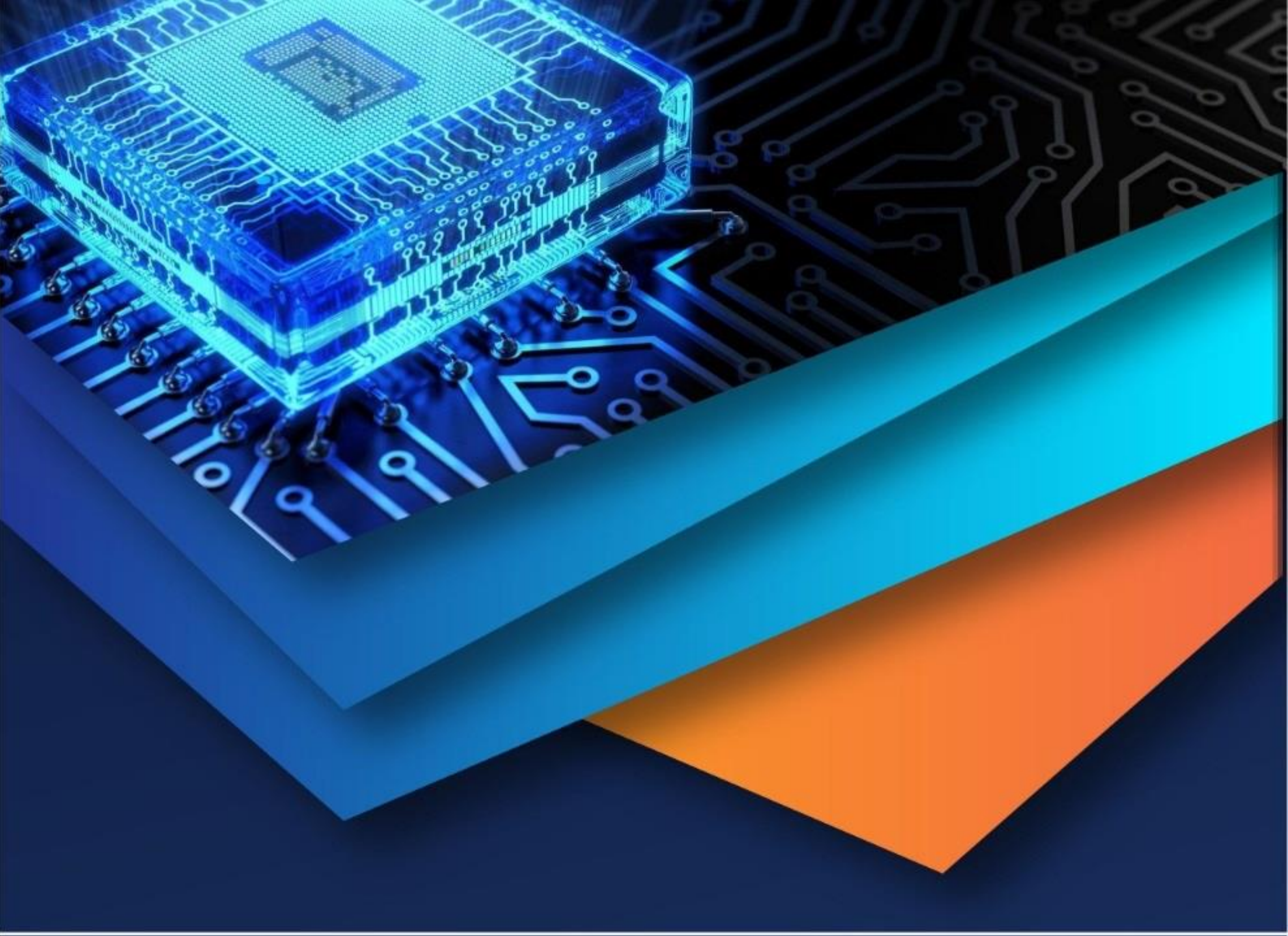
[2] "Enhancement of COP in Vapour Compression Refrigeration System" M. Krishna Prasanna, P. S. Kishore. International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181

[3] "Refrigeration System Performance using Liquid-Suction Heat Exchangers" S. A. Klein, D. T. Reindl, and K. Brownell International Journal of Refrigeration, Vol. 23, Part 8, pp. 588-596 (2000).

[4] "A Review on Analysis of Vapour Compression Refrigeration System Using Matrix Heat Exchanger" Chetan Papade, Biranna Solankar. International journal of latest trends in engineering and technology.(IJLTET)

[5] "Refrigerant charge reduction in vapor compression refrigeration cycles via liquid-to-suction heat exchange" Christian J.L. Hermes International journal of refrigeration 52(2015) 93e99

[6] https://www.researchgate.net/publication/222218901 Refrigeration system performance using liquid-suction heat exchangers



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY