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Improving and Comparing the Coefficient of Performance of Domestic Refgirator by using Refrigerants R134a and R600a

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ABSTRACT

The main objective in present dissertation has been focused on alternative refrigerant to conventional CFC refrigerant, CFC like R12, R22, R134a, etc… are not eco friendly. The emission of these refrigerants causes the depletion of ozone layer etc…. Hence to avoid above difficulty the alternative of refrigerant in the form of R600a has been choosing. R600a refrigerant are natural refrigerant consist of hydrocarbon. In the present work, the performance of the domestic refrigerator is determined using R600a (Isobutane) and comparison with R134a (Tetrafluoro-ethane) as the part of project work the refrigerator setup consists of evaporator, compressor, condenser and expansion valve are chosen with suitable specification. Also in the present work an attempt has been made to improve the coieffiecnt of performance (cop) of the system, by incorporating a heat exchanger before admitting refrigerant into the compressor. Thus the compressor work reduces and it may results increase the performance of the refrigeration system.

KEYWORDS :*Heat exchanger, coieffiecnt of performance, Isobutane, depletion of ozone, alternative refrigerants.*

I. INTRODUCTION

Vapor compression Refrigeration system is an improved type of Mechanical refrigeration system. The ability of certain liquids to absorb enormous quantities of heat as they vaporize is the basis of this system. Compared to melting solids (say ice) to obtain refrigeration effect, vaporizing liquid refrigerant has more advantages. To mention a few, the refrigerating effect can be started or stopped at will, the rate of cooling can be predetermined, the vaporizing temperatures can be govern by controlling the pressure at which the liquid vaporizes. Moreover, the vapor can be readily collected and condensed back into liquid state so that same liquid can be recirculated over and over again to obtain refrigeration effect. Thus the vapor compression system employs a liquid refrigerant which evaporates and condenses readily. The System is a closed one since the refrigerant never leaves the system. The coefficient of performance of a refrigeration system is the ratio of refrigerating effect to the compression work; therefore the coefficient of performance can be increased by increasing the refrigerating effect or by decreasing the compression work.The Vapor compression refrigeration system is now-a-days used for all purpose refrigeration. It is generally used for all industrial purposes from a small domestic refrigerator to a big air-conditioning plant.

1.2 Statement of Problem

The main components of refrigeration system are compressor, condenser, expansion valve and evaporator. In general refrigeration system the entire refrigeration circuit is exposed to atmosphere so that some losses may occur. So the entire refrigeration circuit is placed in the closed cabin. The emission of refrigerants like R12, R22, R134a etc… are causes the depletion of ozone layer. So that the refrigerant R600a has been chosen because it is natural refrigerant consist of hydrocarbon and eco friendly.

In the present dissertation work the heat exchanger is incorporated i.e. the capillary tube is insulated together with suction line of the compressor. So that the heat transfer occur between vapour refrigerant in the suction line and the liquid refrigerant in the capillary tube, so that some precooled liquid refrigerant can enter in to evaporator which is more efficient than regular refrigeration system. This change in temperature of liquid refrigerant entering in to evaporator will increase the coefficient performance of the system.

1.3 objective of the work

1. Determining the actual coefficient of performance of domestic refrigerator using refrigerants R-134a and R-600a.
2. Comparison the coefficient of performance of domestic refrigerators between refrigerants using R-134a and R-600a.
3. Experiments increasing coefficient of performance of vapour compression refrigeration system by incorporating heat exchanger.
4. Comparison the coefficient of performance of domestic refrigerators between refrigerants using R-134a and R-600a after incorporating heat exchanger.

II. EXPERIMENTAL SETUP AND DESIGN DETAILS

Different experimental and theoretical comparison is performed by many researchers to evaluate the performance of domestic refrigerator by using different refrigerants. In this experimental R-600a is compared with the R-134a in a domestic refrigeration system. To perform the experiment 165L refrigerator is selected which was designed to work with R-134a.it is consists of an evaporator, air cooled condenser, reciprocating compressor. Heat exchanger incorporating in system, capillary tube rounded on the entire suction line of system. By the process rounding of capillary to the suction line we reduce that external type of heat exchanger.

Figure.1 Fabrication of Refrigeration Tutor before Heat Exchanger Incorporation

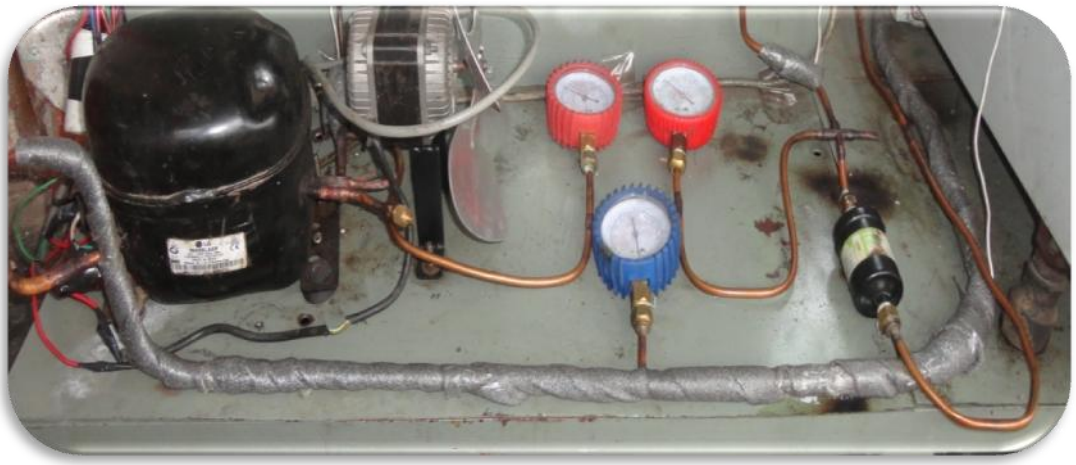

Figure.2 Fabrication of Refrigeration Tutor after Heat Exchanger Incorporation

III. EXPERIMENTAL PROCEDURE

While coming experiment two types of refrigerant using in the refrigerator R134a & R600a ,Putting the freezer regulator at top position so that no need of cut-off easily taken for system..Take down which refrigerant is in application. Take down the energy meter reading no of seconds for 5 revolution of energy meter Take down the reading of compressor pressure discharge inlet & condenser outlet from the pressure gauges. Take down the temperature readings of compressor suction line, discharge temperature, temperature of evaporator and condenser outlet temperature of system. Calculate coefficient of performance & energy consumption. And the experiment is repeated for other refrigerant and the readings are tabulated in the tabular column.

IV. RESULTS AND DISCUSSION

Table reading taken from the experimental procedure of R134a refrigerant placed in the experimental setup. Note the reading of compressor inlet, compressor outlet condenser outlet, evaporator temperature pressure & of various parameters in the setup.

Table.1 Reading of R134a Refrigerant without Heat Exchanger

Operating freezer point	N (rev/sec)	T_1 °c	T_2 °c	T_3 °c	P_1 (bar)	P_2 (bar)	P_3 (bar)	C.O.P
1	61:07	-3.7	53	40	0.68	9.6	9.31	4.22
2	61:12	-5.9	56.9	42	0.62	10.34	9.65	4.20
3	60:00	-9.3	57.5	44	0.55	11.72	11.03	4.16
4	59:00	-11	60	46	0.55	11.72	11.03	3.81

Table .2 Reading of R134a Refrigerant with Heat Exchanger

Operating freezer point	N (rev/sec)	T_1 °c	T_2 °c	T_3 °c	P_1 (bar)	P_2 (bar)	P_3 (bar)	C.O.P
1	46:10	-7.9	54.8	44.3	0.68	17.24	16.55	4.55
2	49:18	-7.9	54.9	42.3	0.55	15.51	14.62	4.44
3	50:30	-9.6	55.6	41.6	0.58	15.72	15.03	4.30
4	49:29	-12	57	42.6	0.58	15.86	15.17	3.9
5	51:20	-15	58.5	43	0.37	15.17	14.48	3.87
6	53:12	-17.8	59.2	43.1	0.344	15.17	14.48	3.64
7	52	-19	60.1	43.1	0.310	14.48	14.13	3.40

Table reading taken from the experimental procedure of R600a refrigerant placed in the experimental setup. Note down reading as per procedure placed.

Table .3 Reading for R600a without Heat Exchanger

Operating freezer point	N (rev/sec)	T_1 °c	T_2 °c	T_3 °c	P_1 (bar)	P_2 (bar)	P_3 (bar)	C.O.P
1	54	-10.6	55.9	45.2	0.14	9.2	8.21	5.76
2	55	-11.6	57.4	45.1	0.13	8.9	8.12	4.12
3	54	-12.2	56.8	43.9	0.14	9.1	7.94	4.76
4	57	-14.1	57.2	43	0.07	8.06	7.79	3.9
5	60	-16.8	58.4	44	0.08	8.34	7.94	3.8
6	57	-17.7	59.3	43.8	0.07	8	7.35	3.7
7	60	-18.3	60	44.3	0.08	7.92	7.24	4.08

Table .4 Reading for R600a Refrigerant with Heat Exchanger

Operating freezer point	N (rev/sec)	T_1 °c	T_2 °c	T_3 °c	P_1 (bar)	P_2 (bar)	P_3 (bar)	C.O.P
1	55:10	-11.6	51.9	41.3	0.13	8.2	7.93	5.2
2	55:10	-11.9	51.7	39.4	0.13	8.4	7.93	5.19
3	56:60	-12.9	52.3	41.7	0.14	8.2	7.91	5.21
4	56:10	-14.6	53.6	39.6	0.06	8.06	7.79	4.15
5	60:20	-17.6	53.7	38	0.06	7.93	7.58	3.6
6	60:09	-19.2	53.3	39.2	0.07	7.44	7.24	4.01
7	60:05	-19.6	53.5	38.6	0.06	7.33	7.17	4.06

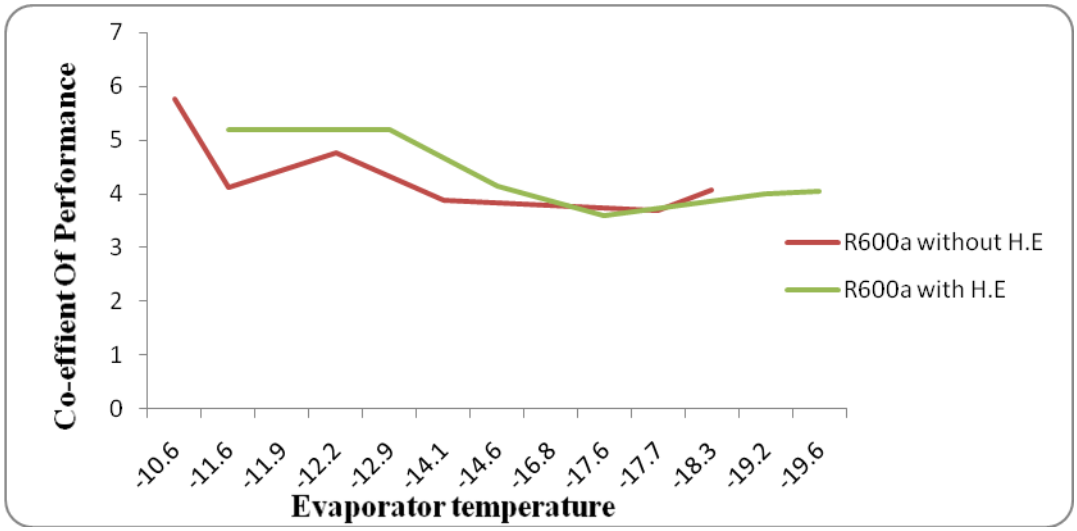

Figure .3 Shows R600a refrigerant Evaporator point V_s C.O.P
Colour Represent in graph Green colour : refrigerant with H.E
Red colour : refrigerant without H.E

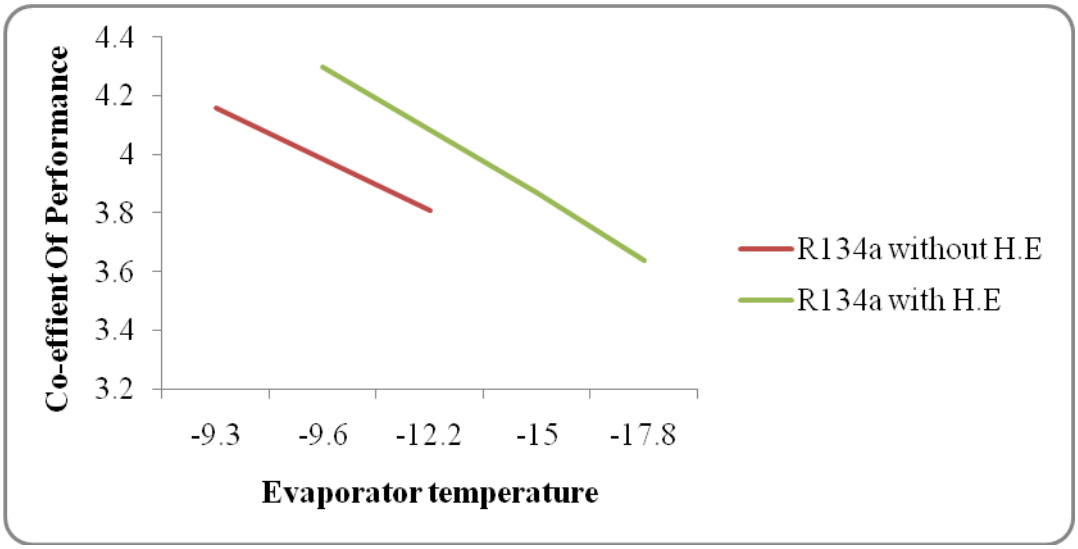

Figure .4 Shows R134a refrigerant Evaporator point V_s C.O.P

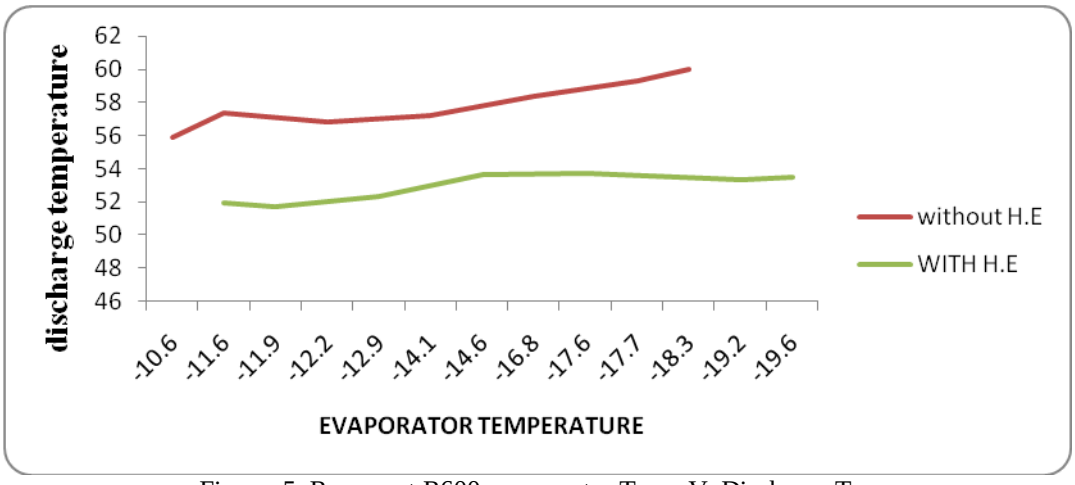

Figure .5 Represent R600a evaporator Temp V_s Discharge Temp

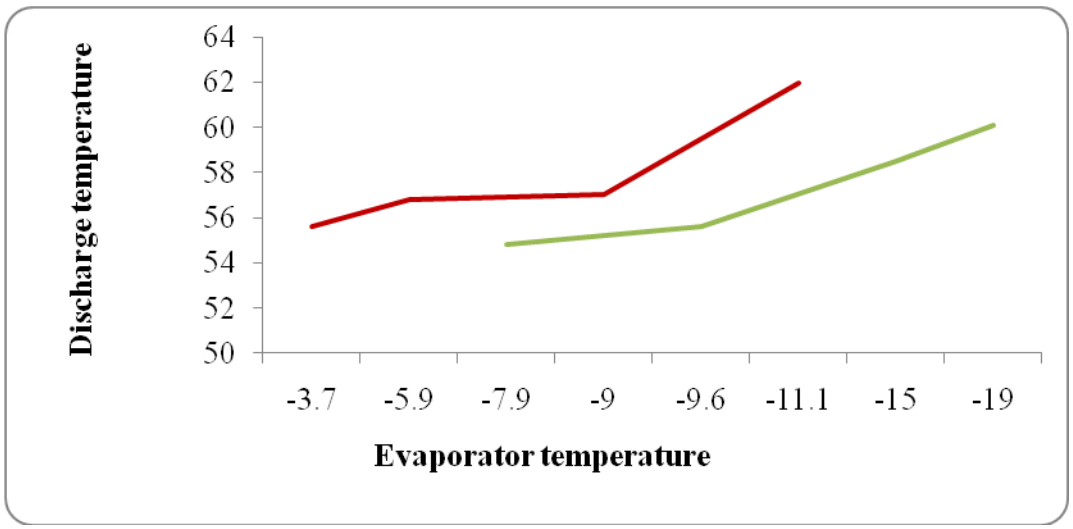

Figure .6 Represent R134a evaporator Temp V_s Discharge Temp

V. CONCLUSIONS

An experiment is conducted on domestic refrigerator by with & without incorporating heat exchanger in the system by using various refrigerants in the fabrication system and their coefficient of performance & energy consumption of the system is calculated.

- Refrigerator carried out using without & with heat exchanger of refrigerant R134a & R600a in system, in which coefficient of performance of refrigerator 0.95 increased by using heat exchanger.
- In the same way the discharge temperature of compressor is decreased with 10% by using heat exchanger , energy consumption refrigerator gradually increased with 3% of compared to normal domestic refrigerator.

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