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IMPROVEMENT IN COEFFICENT OF PERFORMANCE OF DOMESTIC REFRIGERARION WITH TWO REFRIGERANTS (R-134a AND R600a) USING R600a COMPRESSOR AND WRINKLE CONDENSER

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ABSTRACT

Now-a-days, domestic refrigerator systems are important for industrial and domestic applications. Refrigerator mostly works on vapour compression refrigerator. The system consists of components like compressor, condenser expansion value and evaporator. The performance of the system depends upon allthe components of the systems. The main objective in this presents work is to verify the performance of a domestic refrigerator of capacity 165L,by using R-134a and R600a as refrigerants, hermetic sealed compressor(R-600a), and wrinkle shaped condenser having 6.4mm & length 8m and compared with that of the existing system. The main objective was to coefficient of performance of refrigerator using wrinkle condenser (as a copper material) verifying effect of performance using normal condenser made of copper material refrigerator capacity 165lts, further an attempt is made in modifying the convectional shaped condenser to wrinkle shaped and with the pitch angle 90^0 the performance of system is evaluated.Finaly it is noticed that wrinkle shaped condenser has given the maximum cop among all observations

KEYWORDS: Wrinkle shape condenser,R-134a and R-600a refrigerants.

I. INTRODUCTION

Refrigeration is mean to provide and maintain low temperature within the controlled room specifications. The main components of vapour compression refrigeration systemcompressor, condenser, expansion valve and evaporator, each component have their own properties this five component cycsle work done is known as domestic refrigeration cycle.In the refrigeration system, condenser plays an important role as condensing the vapour into liquid phase. It acts as a heat exchanger which absorb and releases heat form the refrigerant asthe condenser used in the system is an air cooled condenser .This helps in avoiding the excess heat into the refrigeration system. Condenser pressures are also helps in improving the efficient percentage of the system .Iron material used to make condenser in past, but it gives low cooling effect and high power consumption so, change in material is necessary for the condenser to result in optimum and good performance in system. Change in shape of condensers may also results in the improving the refrigeration effect and power consumption. Therefore copper material and a wrinkle shaped condenser which has 90^0 angle bent was taken and experiments are done by using R-134a and R-600a refrigerant.

II. EXPERIMENTAL SETUP& METHODOLOGY

Basically in vapor compression refrigerationsystem 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 compression added in the compressor and condenses its back to liquid which is done by condenser. The main focus is on heat rejection in the condenser and the performance of condenser using wrinkle shaped condenser in the present domestic refrigerator and copper material are used. This will also helps in increase of COP onthe system.

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Fig 1:Normal iron condenser

Iron material isused to make condenser in past, but it gives low cooling effect and high power consumption so, change in material is necessary for the condenser to result in optimum and good performance in system

Fig2: Straightening copper tube ***Fig3: Copper tube bender at 90^0angle*** ***Fig4: Wrinklecopper condenser***

Step 1: Straighteningisthefirststepincoppertubeprocessing as shown in fig2.
Step 2: Normally the smaller machine is copper tube bender used to bend the condenser coil into desired shape as shown in fig3.
Step 3:Finally wrinkle shaped condenser is designed with the diameter of 6.4mm and 8m length with pitch angle of 90^0 as shown in fig4.

Copper tubing is the ideal material for many applications. Its strength, the ease with which it is fabricated and soldered, and its high conductivity to heat is invaluable in the process of building homes and industrial building, particularly for the refrigeration and air conditioning equipment installed. Tubing made from copper is one of the few naturally-sourced materials ,so no metal is lost in reclaiming copper from pipes no longer needed, making a good choice for the future.

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Fig 5: R-134a (Tetrafluoro-ethane (CH2FCF3)

TABLE 1:R-134a Properties

REFRIGERANT	R134a
Name	1.1.1.2-Tetrafluoro-ethane
Formula	(CH2FCF3)
Critical temperature in °C	101
Molecular Weight in Kg/Kmol	102
Normal boiling point in	-26.5
Pressure at -25 °C in bar (absolute)	1.07
Liquid density at -25 °C in Kg/I	1.37

Properties of R-134a as shown in tabular column.Tetrafluoro-ethane of gas are shown in fig5.

Fig 6:R-600a (Isobutane [(CH3) 3 CH])

TABLE 2:R-600a Properties

REFRIGERANT	R600a
Name	Isobutane
Formula	(CH3)3CH
Critical temperature in °C	135
Molecular Weight in Kg/Kmol	58.1
Normal boiling point in	-11.6
Pressure at -25 °C in bar (absolute)	0.58
Liquid density at -25 °C in Kg/I	0.60

Properties of R-600a as shown in tabular column.Isobutane of gas are shown in fig6.

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Fig 7: Existing system

Fig 8: Proposed system

Normal condenser(Iron material) and Wrinkle condenser (Copper material) are in same fridge, outside of refrigerator as shown in fig8

Methodology

1. The refrigerator is modified in to the experimental form, pressure gauges and digital thermocouples.
2. It is charged with R134a R600a refrigerant without any leakages. Then the experiments were done in the following procedure:
3. 150 grams of R134a and 70 grams of R600a is taken and poured in to the compressor with the provided inlet.
4. The refrigerator is checked for the connections and it is switched ON.
5. All the temperature, pressure and time readings were taken at different points forevery 5^0C decrease in temperature of the evaporator cabin.
6. With obtained readings the Co-efficient of performance (COP) of the refrigerator is determined by using R134a & R600a P-H chart. After switching off the compressor the compressor off time is tabulated up to 5^0C rise in temperature of the evaporator.
7. The experiments are done with two different refrigerants and readings are tabulated.

Table 3: Comparasion Of Performance Parameters

S.NO	Parameters	R-134a (Iron condenser)	R-600a (Copper condenser)
1	Net refrigerating effect KJ/Kg	183	375
2	Coefficient of performance (COP)	3	3.57
3	Mass flow rate to obtain 1TR Kg/min	1.14	0.56
4	Work of compression KJ/Kg	60	105
\5	Heat equivalent of work of compression per TR KJ/min	68.8	58.85
6	Compressor power KW	1.147	0.98
7	Heat to be rejected in condenser KJ/Kg	243	480

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III. RESULTS AND DISCUSSION

The performance of vapor compression refrigeration system on with wrinkle condenser is done and compare with the existing condenser. The existing condenser cop is 3.14 and wrinkle condenser coil with pitch angle 90^0cop is 3.57. To illustrate these effects, calculated values of wrinkle condenser cop and refrigeration effect, power consumption, heat rejection in condenser, are shown in figures

Comparison of Refrigeration effect

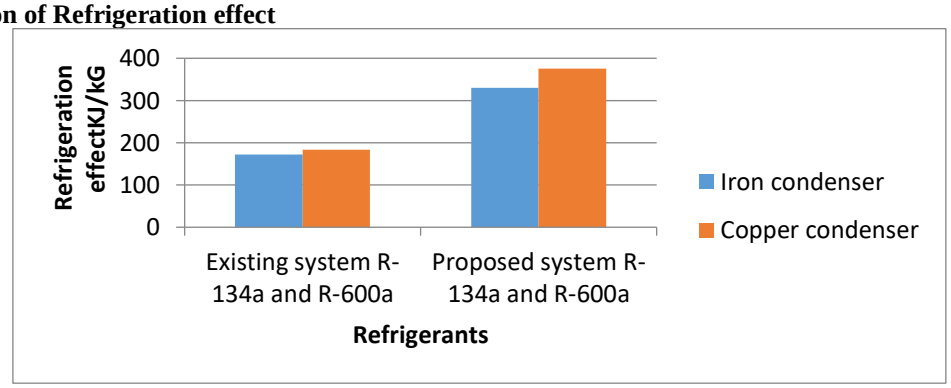

Fig 3.1: Refrigeration effect vs Refrigerants

The variation of refrigeration effect with Refrigerants shows that the copper condenser of R600a Refrigerant will provide more refrigeration effect than the condenser of R134a Refrigerant.

Comparison of Heat rejection in condensers

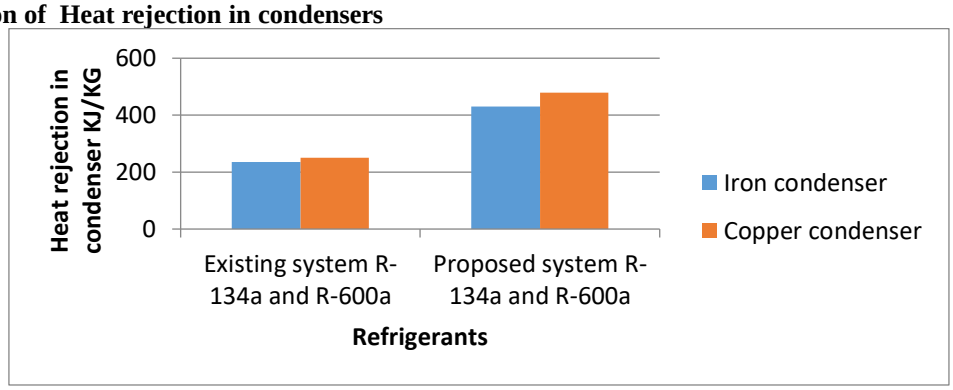

Fig 3.2: Heat rejection in condenser vs Refrigerants

From fig 5.2 it is clear that heat rejection in proposed system is more when compared with existing system.

Comparison of Coefficient of performance

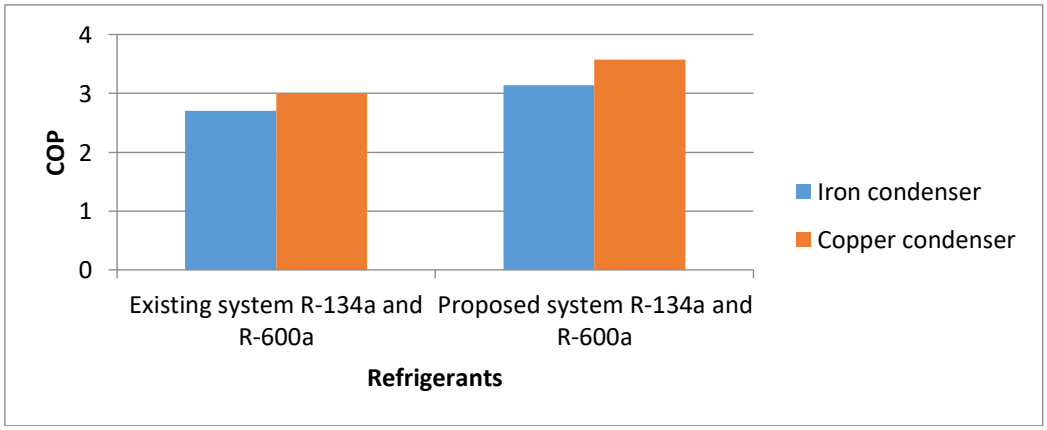

Fig 3.3: Coefficient of performance vs Refrigerants

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The variation of cop with Refrigerants shows that the copper condensers of R600a Refrigerant provide more COP than the condenser of R134a Refrigerant.

Comparison of Power consumption

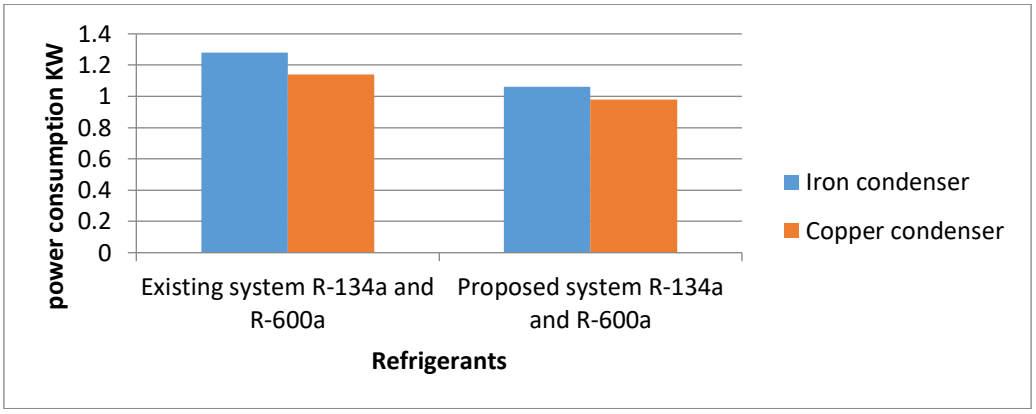

Fig 3.4: Power consumption vs Refrigerants

The variation of power consumption with Refrigerants shows that the copper condensers of R600a Refrigerant provide low power consumption than the condenser of R134a Refrigerant.

IV. CONCLUSION

The COP of the system is increased with the standard condenser coil of 6.4mm diameter, 8m length for the normal condenser. The COP of copper is **3.57** which shows its increase by a value of 12% when compared with normal (Iron) condenser with cop value of 3.14.Finally it is concluded that wrinkle shaped condenser coil of diameter 6.4mm, 8m length with pitch angle of 90 is recommended for domestic refrigerator of 165liters capacity with R-134a and R-600a as refrigerant.

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