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PERFORMANCE ANALYSIS OF DOMESTIC REFRIGERATION SYSTEM USING ECONOMIZER

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ABSTRACT: ***In present days it is difficult to find out more suitable eco-friendly and more efficient vapor compression cycle. Using economizer enable us to reduce cooling time. R404a refrigerant contributes towards eco-friendly system and having better performance. Comparative analysis between VCR system and VCR with economizer enables us to achieve better enhancement in refrigeration field. Heating load calculation totally derived from industrial existing method. COP of this system will be slightly more than normal VCR system. There will be lots of scope related to VCR system like effect of refrigerant, change in design of components, change in structure, improvement in working components. Cooling time is the most important factors of our analysis through introducing economizer. The design of economizer also plays an important role in reduction in cooling time.***

Keywords: VCR System, COP, Economizer, Domestic Refrigeration System, Refrigerant

1. INTRODUCTION

Saving energy has become an important issue in economic development and with increasing worldwide population. High efficiency refrigeration cycles are commonly used in housing and industrial refrigerators, and many studies have been conducted to improve their efficiency.

Refrigeration may be defined as lowering the temperature of an enclosed space by removing heat from that space and transferring it elsewhere. The most frequently used refrigeration cycle is the vapor compression refrigeration cycle.

Ideal vapor compression refrigeration cycle results, by eliminating impracticalities associated with reversed Carnot cycle such as vaporizing the refrigerant completely before compression, replacing turbine with throttling device (expansion valve or capillary tube).

Present work deals with the improvement of vapor compression refrigeration system by using economizer. In this work, economizer is installed at system. In vapor compression refrigeration system, condenser is used to remove heat from high pressure vapor refrigerant and converts it into high pressure liquid refrigerant.

Working of this system is very similar to normal VCR system when the HSV valve is open and solenoid valve is closed because of having direct supply of refrigerant leaving the receiver to the filter. But when the HSV valve is closed and solenoid valve is open then refrigerant passes through the economizer. The refrigerant leaving receiver has a high temperature as compared to refrigerant leaving evaporator which in turn led to heat transfer between both supplies. The refrigerant leaving evaporator gets heats from the refrigerant of receiver and gets high temperature which supplied to compressor. The temperature of refrigerant supplied to evaporator is reduced.

An economizer is a mechanical device used to reduce energy consumption. Economizers recycle energy produced within a system or leverage environmental temperature differences to achieve efficiency improvements.

Some of the common applications of economizer are as follows. In steam power plant it captures the waste heat from boiler stack gases and transfer it to the boiler feed water. Air-side economizers HVAC (heating, ventilation, and air condition) can save energy in buildings by using cool outside air as a means of cooling the inner space. Refrigeration: this is commonly used in industrial refrigeration where vapour compression refrigeration is essential. Systems with economizer aim to produce part of the work at high pressures, a condition in which gas compressors are normally more efficient.

Advantages and Benefits of Economizer:
It recovers more heat of flue gases which normal air pre-heater cannot do. Due to increase in fuel prices, all power plants are facing pressure for increasing boiler efficiency. So by using economizer, this pressure can be minimized.

3. LITERATURE REVIEW

3.1 Dr. Nimai Mukhopadhyay, Mr. Bodhisattwa Maity

In this study a mathematical model of cold storage (with the help of computer programming; and other mathematical tools) has been proposed which can be used for further developments in the field of refrigeration – science and technology; the proposed model aims for the development of cold storage in the upcoming future. In this paper we have proposed a theoretical comparative study of heat load distribution model of a cold storage. Velocity of air (v) temperature difference (dt), Relative humidity (Rh) are the basic variable and three range are taken each of them in the model development.

3.2 J.W. Jeong and Y. L. Lee

Many studies have been conducted to overcome the deterioration of COP (coefficient of performance) that occurs from lowering the evaporating temperature of a cascade cycle to extremely low temperatures. This study applied economizers to low stage and high stage cycles to enhance the performance of theR134a-R404a cascade cycle. Cycle analysis was performed to examine changes in cycle performance with condensing temperature, evaporating temperature, cascade temperature difference and economizer ratio. Numerical analysis revealed a 13% improvement in both cooling capacity and COP from applying an economizer to the low stage cycle. The optimal temperature difference of the cascade heat exchanger was approximately $6^{o}C$.

3.3 Poonam Dhankhar

Refrigeration is a basic method of food preservation. All the refrigeration methods for food preservation are based on Reverse Carnot cycle, which explains Adiabatic and Isothermal Expansion and Compression. Basic components used in these cycles are Evaporator, Compressor, Condenser and Expansion Valve. Generally used cycle is Vapor Compression Cycle. Other cycles are Vapor Absorption Cycle, Gas Cycle. Other new methods of Refrigeration Are Thermoelectric and Magnetic Refrigeration. Various types of refrigerants are used in these cycles based upon their properties. Commercially Refrigeration is used as preservation method in various food industries like Dairy and Meat Processing industry.

3.4 Prof. J. H. Bhangale, Prof. D. D. Palande

An Evaporator is the Main component of refrigeration system, which is mainly used in different refrigeration and air-conditioning applications in food and cold storage, in the mechanical industry etc. Evaporator in air conditioning system is used to evaporate liquid and convert in to vapor. While absorbing heat in the processes for the refrigeration cycle to be efficient; the design parameters for its key components play a vital role. For this research work, the effort is to identify the effect of geometry for the evaporator coil over the performance of the refrigerator. Typically, the cross section of the tube and the method of fitment e.g.- grooved construction, over the evaporator shall be studied using methodology. The results using CFD methodology shall be validate using representative miniature prototype for demonstration for the enhancement. The evaporator is one of the four basic and necessary hardware components of the air conditioning system, drop in pressure, heat transfer, evaporation rate and the important thing is efficiency of evaporator, all these things are improving by considering optimum parameter of evaporator, this optimum parameter of evaporator will generate with the help of experimental data and CFD analysis.

3.5 Abhishek Tiwari and R.C. Gupta

This paper presents an experimental study of R404a and R134a, environment-friendly refrigerants with zero ozone depletion potential (ODP) and low global warming potential (GWP), to replace R134a in domestic refrigerator. A refrigerator designed and developed to work with R134a was tested, and its performance using R-404a was evaluated and compared with its performance when R134a was used. The results obtained showed that the design temperature and pull-down time set by International Standard Organization (ISO) for small refrigerator were achieved earlier using refrigerant R-404a than using R-134a. The system consumed less energy when R-134a was used. The performance of R-404a in the domestic refrigerator was constantly better than those of R134a throughout all the operating conditions, which shows that R-404a can be used as replacement for R134a in domestic refrigerator.

4. DIMENSION OF EXPERIMENTAL SET UP

NO	COMPONENT	CAPACITY
1	COMPRESSOR	0.058 TR
2	CONDENSER	0.5 TR
3	RECEIVER	0.5 Liter
4	COOLING COIL	0.225 TR

5	**FILTER**	**1 Unit**
6	**SOLENOID VALVE**	**2 Unit**
7	**SIGHT GLASS**	**1 Unit**

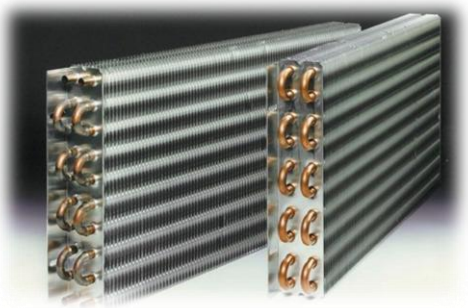
(TR = Ton of Refrigeration)

5. PARTS

5.1 COMPRESSOR

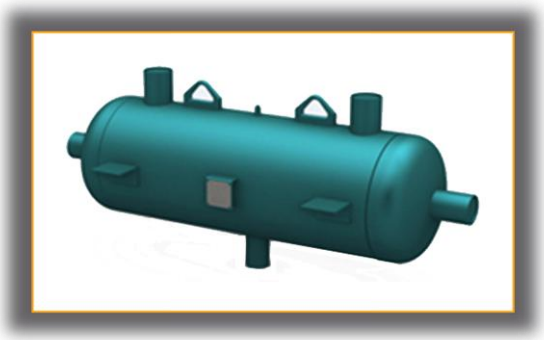
5.2 CONDENSER

5.3 EVAPORATIVE COIL

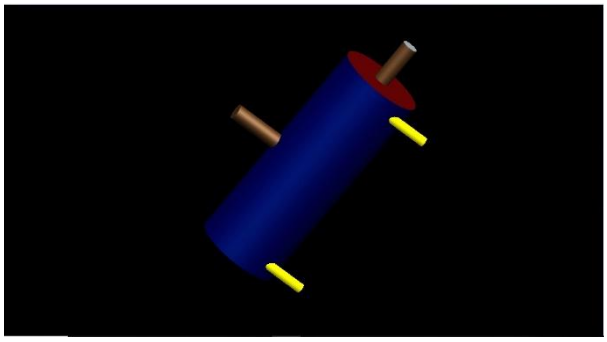


5.4 EXPANSION VALVE

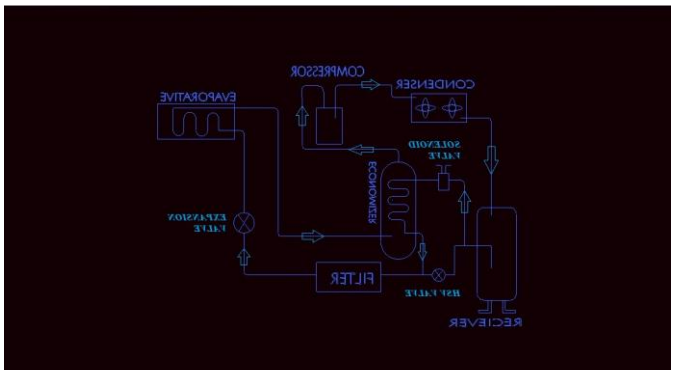
5.5 RECIEVER TANK



5.6 CAD DESIGN OF ECONOMIZER



5.7 BLOCK DIAGRAM



6. ACTUAL MODEL

7. RESULT

SYSTEM	COP	COOLING TIME (FOR -9^{O}C)
WITHOUT ECONOMIZER	**0.167**	**45 Min**
WITH ECONOMIZER	**0.202**	**37 Min**

8.CONCLUSION

From the above result we can conclude that by adding economizer in the system COP of the system increases and cooling time of the system reduces.

9. REFRENCES

1) Arora, C.P. Refrigeration and Air Conditioning. Second edition. Tata McGraw-Hill
2) Heat Tranfer: Principles and Applications, Dutta, Binay k (Book)
3) Refrigeration and Air Conditioning, W.F.Stocker and J.W.Jones
4) S. Venkataiah., G. Venkata Rao., A Comparative Study of the Performance Characteristics of Alternative Refrigerants to R-22 in Room Air-conditioners. International Journal of Engineering Research and Technology Volume 6, Number 3, page No.333-343 (2013)
5) AbdelAziz, O., Singh, V., Aute, V., Radermacher, R., 2008. A-type heat exchanger simulation using 2-d cfd for airside heattransfer and pressure drop. In: 12th International Refrigeration and Air Conditioning Conference at Purdue, No.2200. West Lafayette, IN, USA.
6) Rameshwar B. Hagote and S. K. Dahake, Enhancement of Natural convection heat transfer coefficient by using V-fin array, International Journal of Engineering Research and General Science Volume 3, Issue 2, March-April, 2015.
7) Comakli K, Simsek F, Comakli O andSahin B (2009), "Determination of Optimum Conditions R-22 and R404aRefrigerant Mixtures in Heat Pumps Using Taguchi Method", *Applied Energy, Vol. 86, pp. 2451-2458.*
8) Aprea C, Mastrullo R and Renno C (2004), "An Analysis of the Performance of a Vapor Compression Refrigeration Plant Working Both as a Water Chiller and a
9) ISHRAE Publications, Air conditioning and Refrigeration.
10) Mass and heat transfer, R.K.Rajput. (Book)