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**Performance Enhancement of Household Refrigerators with Cooling of Compressor: A
Review**

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Abstract

This paper presents a review of experimental tests carried out to investigate the performance of a household refrigerator. The purpose of this review paper is to summarize the important published papers on the enhancement of performance of refrigerator by cooling of compressor. The compressor compartment is an important part of refrigerator. Due to running of compressor high temperature generates on interior air volume. To decrease this temperature inner base of refrigerator ventilate with a Fan. When the fan will run than decreases the heat generation in compressor compartment & decrease the temperature of the surfaces close to the compressor. Hence there are lower CO₂ emissions to the environment & make more efficient. [1]

Keywords: Refrigerator, Compressor, Fan, Surface ventilate, energy efficiency..

Introduction

Domestic refrigerators are identified as major energy consuming domestic appliances in every household. The function of the compressor is to take the refrigerant vapour from evaporator at low pressure and low temperature and compress it to a high pressure and high temperature. In vapour compression system the major operating cost is the energy input to the system in the form of mechanical work. The Compressor is certainly the largest power consumer in a vapour compression system. Hence the efficiency of the compressor is very important for high efficient vapour compression system used for refrigeration and air conditioning purpose. [4]

In almost all domestic refrigerators all components are assembled in the same relative position since several years ago. It is also known that the condenser releases heat at high temperatures (first law of thermodynamics) as well as the compressor. This heat is rejected to the environment in almost all practical situations partially by natural air convection. However, part of it is due to thermal radiation that causes an overheating of the refrigerator surfaces adjacent to that equipment. As a consequence there are more heat gains to the refrigerator through these surfaces and hence higher air temperatures inside it. [2]

In Household Refrigerator consumes about 26% of the residential electricity demand and they are estimated to be responsible 70% of the overall greenhouse gas emission in the country. [5]

In refrigerated space various parts are placed inside in an arbitrary order based on the principle that the inside air temperature is constant through the space. This is because there are difference in temperature due to air circulation from the evaporator (natural or forced convection). [7]

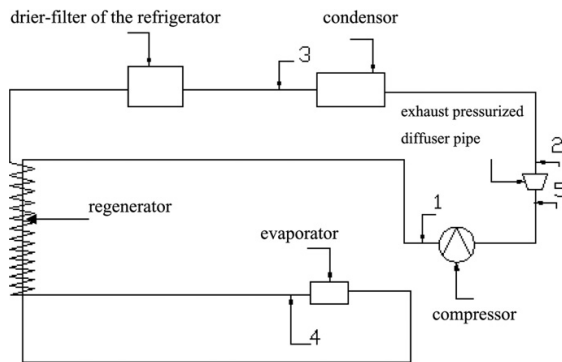
Literature Review

The following literature review describes important research results regarding the cooling of compressor in household refrigerator.

- **Clito Afonso (2012)** – This paper presents the enhancement of refrigerator efficiency by air cooling of compressor. In this work generally compressor compartment ventilate with a planum wall and fitted a small size Fan which gives air cooling of compressor. In this research observed that there are decreases 11°C Temperature of the compressor surface and decreases in energy consumption of the entire system. [1]
- **Clito Afonso, Joaquim Matos. (2006)** – In this work study the effect of radiation shields around the air condenser and compressor of a refrigerator on

the Temperature distribution inside it. In this work it was shown that with minor modifications in the available commercial refrigerator. it is possible to have a decrease in the inside air temperatures. These modifications simply consist in covering the external rear wall of the refrigerator and the compressor recess wall with a sheet of aluminum foil avoiding in that way the radiation heat transfer from the condenser and the compressor to the external surfaces of the refrigerator. [2]

- **YicaiLiuKai Chen, TianlongXin, LihongCao(2011)**-This paper has examined the application of prototype diffuser pipes in a refrigeration system. The refrigerator with diffuser pipe was constructed in this study and then compared with a refrigerator without an exhaust/suction-pressurized and energy-saving diffuser pipe. Two kinds of diffuser pipes have been used: exhaust and suction-pressurized and energy-saving diffuser pipe. The diffuser pipes have been installed behind the exhaust port and in front of the suction port. The experimental data were presented supports the theoretical findings. This novel refrigeration system is more reliable and has higher COP, and lower energy costs, making it more attractive than conventional ejector refrigeration cycles. [3]



- **Mr.V.M.Jamadar, Prof. A.M.Patil.(2012)** – In this paper Compressor is cooling by internal cooling method and external cooling method. The performance of vapour compression system is evaluated at constant cooling load by using compressor cooling coil & without cooling coil. This is investigated on R134a. [4].
- **K. AzzouzD. Leducq, D. Gobin(2009)** - Thiswork investigated the experimental tests carried out to investigate the performance Of a household refrigerator using a phase change material (PCM). The experimental study of a

household refrigerator equipped with a latent storage unit on the unused face of the evaporator shows an enhancement of the system performance and a reduction of the temperature fluctuations in the refrigerated cell. [5].

- **Sreejith K.(2013)**- In this paper get reading by different types of compressor oil for cooling purpose. In this SUNISO 3GS mineral oil uses in a refrigerator. Polyol-ester oil (POE) oil also uses as conventional lubricant. The main conclusion of this experiment is the HFC134a / SUNISO 3GS mineral oil work normally & efficiently in refrigerator with water cooled condenser

The energy consumption of refrigerator reduce between 8-11% of Refrigerator [6].

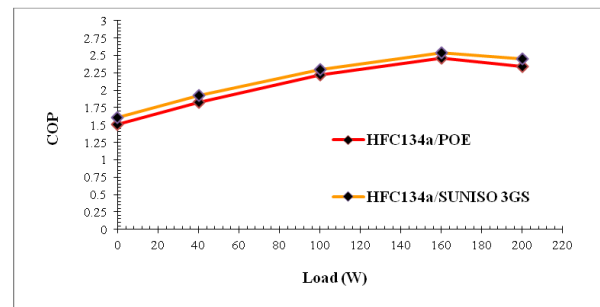


Fig.- Variation of COP With Load

- **C. ConceiçãoAntônio, C.F. Afonso(2009)**-in this paper evaluate the In refrigerated spaces, the inside air is cooled by a heat sink operating either by forced or natural convection. This work studies temperatures in a commercial household refrigerator that were monitored with thermocouples located at several points. The measured temperatures were then compared with those obtained from two different simulation tools. In all refrigerated spaces, it is important to understand the inside Air temperature distribution to know the best places to locate products due according to their specific characteristics. [7].
- **N.Austin, Dr.P.Senthil Kumar,N.Kanthavelkumaran(2012)**--In this paper Invested ozone friendly, energy efficient, user friendly, safe and cost-effective alternative refrigerant for HFC134a in domestic refrigeration systems. This experimental investigation carried out to determine the performance of a domestic refrigerator when a propane/butane mixture is used as a possible replacement to the traditional refrigerant R134a.

The system was evacuated with the help of vacuum pump to remove the moisture and charged with the help of charging system. The temperature inside the chamber was maintained at 25°C and 28°C. When the temperature and humidity inside the chamber was at steady state, the experiments were started. The experiment has been conducted on the domestic Refrigerator at no load and closed door conditions. [8].

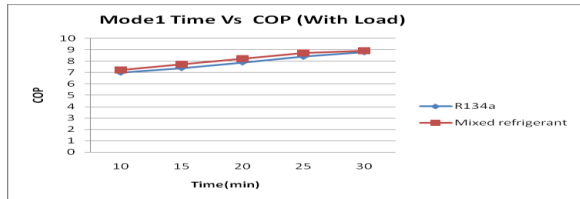


Fig.- Time Vs COP with Load.

- **Ami Prakash (2013)** – In this paper gives conclusion for increasing COP of refrigerator by decreasing compressor work and by increasing refrigerating effect. This work is done by increasing degree of sub cooling of refrigerant which increases the refrigerating effect.[9].
- **Jong Kwon Kim, Chul Gi Roh, Hyun Ksim (2011)**- In this work, an inherent capacity modulated linear compressor for a refrigeration application is investigated through numerical simulations and experiments. This work starts from the variable stroke mechanism, a free piston system, which makes it possible to produce a novel design for an inherent capacity modulated linear compressor. A prototype of an inherent capacity modulated linear compressor that produces capacity according to the cooling demand of a household refrigerator was developed through a numerical approach. [10].

All the Literature Review are summarized in table-1 given below as:-

S.No	AUTHERS	Title Description	Medium Of Cooling Of Compressor	Description Of Experimental Setup
01	Clito Afonso, Joaquim Matos. (2006)	The effect of radiation shields on compressor	Decrease in the inside air temperatures. covering the external rear wall	The freezer works with a standard vapor compression cycle with 0.13 kg of R-134a as a refrigerant. The double door refrigerator was monitored.
02	Clito F. Afonso (2012)	Heat transfer enhancement of the outer shell of household refrigerators	Compressor cooling by forced air ventilation.	The ventilation system (plenum and fan) was designed to ensure a continuous air flow through the outer surface of the compressor.
03	V.M.Jamadar, Prof.A.M.Patil. (2012)	Performance enhancement by cooling of compressor.	By using compressor cooling coil & without cooling coil.	Household refrigerator tested with cooling & without cooling coils.
04	K. Azzouz D. Leducq, D. Gobin (2009)-	Experimental tests carried out to investigate the performance Of a household refrigerator	By using phase change material(PCM)	Household refrigerator covered with phase Change material.
05	Yicai Liu Kai Chen, Tianlong Xin, Lihong Cao(2011)-	Enhancement efficiency by using prototype diffuser pipes in a refrigeration system.	By using diffuser pipe.	Household refrigerator connected with two Types of diffuser pipes. Exhaust port and in Suction port.

06	C. ConceiçãoAntónio, C.F. Afonso(2009)	Air temperature inside Refrigeration cabin.	The inside air is cooled by a heat sink operating either by forced or natural convection	It works with temperatures in a commercial household refrigerator that were monitoredwith thermocouples located at several points.
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Conclusions

1. Cop of vapor compression cycle is increased by lowering the power consumption/work input or increasing the refrigerating effect. This is done by using a thermal radiation shield around the air condenser & compressor in refrigerator .[2]
2. In this work it was shown that with minor modification in the available commercial refrigerator,It is possible to increase the COP of VCRS by lowering the power consumption/work input or by increasing the refrigerating effect.[9]
3. This work presents a modification that was carried out on a commercial refrigerator, in order to improve its efficiency using different cooling loads methods.When system is operated by compressor cooling than COP of the system is greater than without compressor cooling. [4]
4. This work has examined the application of prototype diffuser pipes in a refrigeration system. Two kinds of diffuser pipes have been used: exhaust and suction-pressurized and energy-saving diffuser pipe. The diffuser pipes have been installed behind the exhaust port and in front of the suction port.[3]
5. When experiment is carried out in this work than increasing the performance of refrigerator by using air cooling of compressor with a fan.It can be seen there are saving global electricity consumption &corresponding decrease emission.[1]
6. The experimental study of a household refrigerator equippedwith a latent storage unit by using PCM (phase change material). [5]
7. The energy consumption of the HFC134a refrigerator using SUNISO 3GS mineral oil as the lubricant reduced the energy consumption of the household refrigerator between 8% and 11% for different loads.[7]

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