

# PERFORMANCE OPTIMIZATION OF DOMESTIC REFRIGERATOR USING LPG AS A SUBSTITUTE REFRIGERANT

R.Prabin<sup>1</sup>, I.R Nibin Raj<sup>1</sup>, G.S Gokul Krishna<sup>1</sup>, Dr.N.Kanthavelkumaran<sup>2</sup>

<sup>1</sup>UG Scholar, Mechanical Engineering, Ponjesly College of Engineering, Alamparai, Tamilnadu

<sup>2</sup>Professor, Mechanical Engineering, Ponjesly College of Engineering, Alamparai, Tamilnadu

\*\*\*

**Abstract** - Domestic refrigerator intended to work with R-134a was utilized as partner examination unit to evaluate the possibility of abuse blended refrigerants. The presentation of the fridge abuse blended refrigerant was researched and contrasted and the exhibition of cooler once R-134a was utilized as refrigerant. The consequence of condenser temperature and evaporator temperature on COP, refrigerating outcome was determined. The energy utilization of the fridge all through explore different avenues regarding blended refrigerant and R-134a was estimated. The outcome shows the lasting running and cycling results appeared that R134a with a charge of 100 g or blended refrigerant in with charge of 80 mg or extra fulfill the ideal profound cooler air temperature of  $-18^{\circ}\text{C}$ . All time low electrical energy utilization was accomplished exploitation blended refrigerant in with heat level is a more modest sum than  $-18^{\circ}\text{C}$ . This combination accomplished higher volumetric cooling limit and lower Freezer air temperature contrasted with R134a. Test consequences of the homegrown fridge abuse blended refrigerant were contrasting and those utilizing R134a. During a last yield might be an intense change while utilizing a blended refrigerant contrasted and R134a. This is frequently a sign of better of blended refrigerant as refrigerants. When the outcomes get during this test, it had been show a positive sign of utilizing blended refrigerant as refrigerants in domestic refrigerator.

**Key Words:** Refrigerators, LPG, Substitute Refrigerant, petroleum, Capillary tube

## 1. INTRODUCTION

Refrigerators are widely used to store food sources which break down at encompassing temperatures; waste from bacterial development and different cycles are much slower at low temperatures. Typical coolness was spread what's more, utilized in both business and residence application in the center 1800s to refrigerate food. The suggestion that cold could be delivered by the constrained vanishing of a rash fluid under diminished tension had been recently sought after by Willam Cullen in the 18<sup>th</sup> century. A homegrown cooler is a cooling machine containing a thermally protected separated region and a warmth siphon-component or careless methods - to move heat from it to the outside air cooling the substance to a temperature beneath surrounding. A mechanical assembly portrayed as a "cooler" keeps a temperature a slight degrees over the edge of

freezing over of water; a comparative gadget which keep a temperature beneath the edge of freezing over of water is known as a "freezer." The fridge is a genuinely present day creation among kitchen machine. It supplanted the fridge, which had been a typical homegrown machine for right around a century and a half prior.

Because of the immense interest of power over the world, we consider recuperating the energy which is now spent yet not being used further, to conquer this emergency with less speculation. The climatic change and an Earth-wide temperature boost request open and reasonable cooling frameworks as fridges and air conditioners. Yearly Billions of dollars are spent in filling this need. Henceforth forward, we recommend COST FREE Cooling Frameworks. In spite of, the fact that administration offices can't consistently supply a significant segment of power in both the metropolitan just as in country territories. Still individuals in these areas require refrigeration for an assortment of socially important purposes like virus capacity or putting away clinical supplies and homegrown kitchens this undertaking has the oddity of utilizing LPG rather than power for refrigeration. This arrangement is convenient for refrigeration in districts having alarms in power. It chips away at the rule that during the change of LPG into vaporous structure, extension of LPG happens. Because of this extension there is a pressing factor drop and expansion in volume of LPG that outcomes in the drop of temperature and a refrigerating impact is delivered. This refrigerating impact can be utilized for cooling purposes.

## 2. LITERATURE REVIEW

Prashant Sharma (2012) [1], paper gives an insightful calculation of the pressing factor in a slim cylinder. The recipe is gotten for assessing the necessary length for hairlike cylinder during the plan. Mohammed Aasim Nazeer Ahmad (2014) [2], presents a trial investigation of isobutene (R 600a) a climate well disposed refrigerant with zero ozone consumption potential (ODP) and exceptionally low an unnatural weather change potential (GWP) for the substitution R-134a in homegrown coolers. The COP and other outcome get in this examination show a positive sign of utilizing blended cooler. The utilized blended refrigerant properties like, 24.4% propane, 56.4% butane and 17.2% isobutene.

N.Austin (2012) [3], completed experimentation a family fridge intended to work with R-134a was utilized as an examination unit to survey the possibility of utilizing blended refrigerants. The presentation of the fridge utilizing blended refrigerant was explored and contrasted and the exhibition of cooler when R-134a was utilized as refrigerant. The impact of condenser temperature and evaporator temperature on COP, refrigerating impact was explored. The energy utilization of the cooler during explore different avenues regarding blended refrigerant and R-134a was estimated. The result shows that perpetual running of cooler and cycling results showed that R134a with a charge of 100g or blended refrigerant in with charge of 80mg or more fulfill the necessary cooler air temperature of  $-12^{\circ}\text{C}$ .

### 2.1 Objectives

- 1) To recognize the type of lingering waste in customary Refrigeration framework.
- 2) Compare the significant qualities between LPG Refrigeration framework and customary refrigeration framework.
- 3) To recognize the current existing fridge Cost and assessed cost of LPG cooler.
- 4) The exhibition of existing fridge and LPG Refrigerator is to be looked at.
- 5) To decide the cop of fridge utilizing LPG as refrigerant.

### 2.2 Extension

- 1) The future extent of this undertaking is to zero in on execution of the venture in the café and local area corridor for safeguarding vegetables, dairy items with the refrigeration, where it fills the need of protections.
- 2) This sort of framework can be executed on the food trucks also where it can store in different amounts.
- 3) To make turning out model for LPG refrigeration.

### 2.3 Problem Statement

LPG which is put away gadgets like chambers at high pressing factor is removed. Its pressing factor and stream rate is constrained by a valve associating it to the narrow cylinder at essential amount. Evaporator changes it from condensed state over to vaporous state and grows, so it retains heat as idle warmth because of this interaction. Anyway heat from the environmental factors is assimilated, so a cooling impact is created. This outcome in figuring the cooling impacts at various stream paces of LPG gas.

## 3. COMPONENTS OF LPG REFRIGERATION SYSTEM

1. **LPG Gas Cylinder:** Liquefied Petroleum Gas is mix of Propane ( $\text{C}_3\text{H}_8$ ) and Butane ( $\text{C}_4\text{H}_{10}$ ). LPG is utilized as a fuel for homegrown reason, utilized for drying reason in businesses, LPG is utilized for green reason, cooking, warming fuel.
2. **Capillary Tube:** It is long protracted copper cylinder and it is wound to refrigeration in a few turns with the goal that the slender cylinder is of 2.28 mm for better execution. They

have little inner width. Inward distance across tubes an application fluctuates from 0.5 (0.020 to 0.09 inch). The fine refrigerant enters through the fine cylinder, its pressing factor drops down abruptly because of its little distance across.

3. **Evaporator:** It's the evaporators where the real cooling impact happens in the refrigeration frameworks. The evaporators are heat exchanger surface that move the warmth from the substance to be cooled to the refrigerant, in this manner eliminating the warmth from the lodge.

4. **Pressing factor checks:** Instruments that are utilized to quantify pressure are called pressure measures or vacuum measures. These checks are accessible in 63mm, 100mm, and 150mm sizes and can be tweaked according to client necessity. A Bourdon check utilizes a looped tube, which, as it extends because of pressing factor expands causes a pivot of an arm associated with the cylinder.

5. **Computerized Temperature test:** An advanced temperature test is a gadget that accommodates temperature estimation through an electrical sign

6. **ON/OFF Valve:** A stream control valve is utilized to control the stream or pressing factor of a liquid.

This work replaces the customary refrigerant by LPG as a cooling medium in a cooler. It deals with the rule that during the difference in LPG from fluid into vaporous structure, extension of LPG happens. Because of this extension pressure drop happens and expansion in volume of LPG. It brings about the drop of temperature and a refrigerating impact is created and it is utilized for cooling purposes. In this refrigeration framework the high-pressure LPG is gone through narrow cylinder and it extends, after development the stage change happens and it convert from fluid to gas. At that point it goes through the evaporator where it assimilates the inactive warmth of the put away item and produces the refrigerating impact.

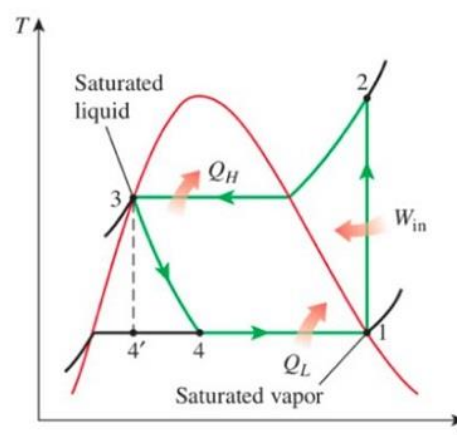


Fig 1. T-S diagram of simple vapor compression refrigeration cycle

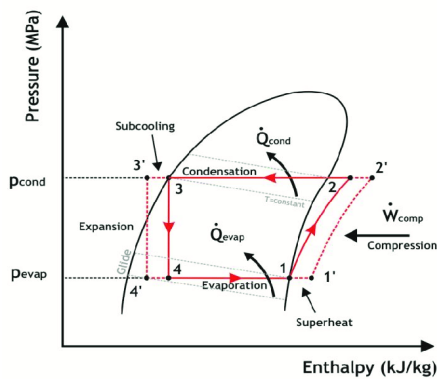


Fig 2. P-h diagram of simple vapor compression refrigeration cycle

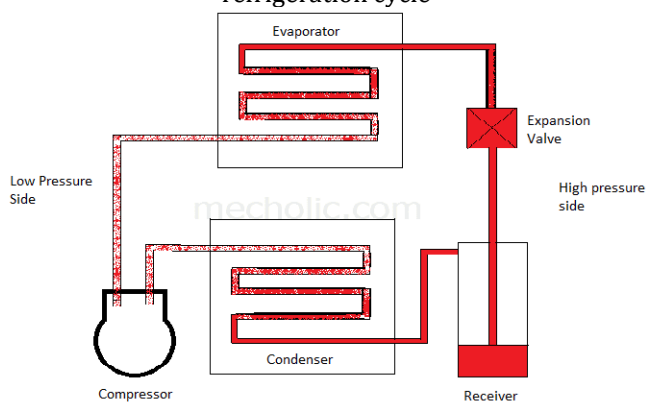


Fig 3. Mechanism of a simple vapor compression refrigeration cycle

#### 4. EXPERIMENTAL SETUP & TEST PROCEDURE

This segment gives a depiction of the offices created for directing trial work on a homegrown fridge. The strategy of charging and departure of the framework is additionally talked about here. Trial information assortment was completed in the exploration research facility of our establishment. The trial arrangement of the test unit and device is appeared in the Fig.4.

##### 4.1 Experimental method

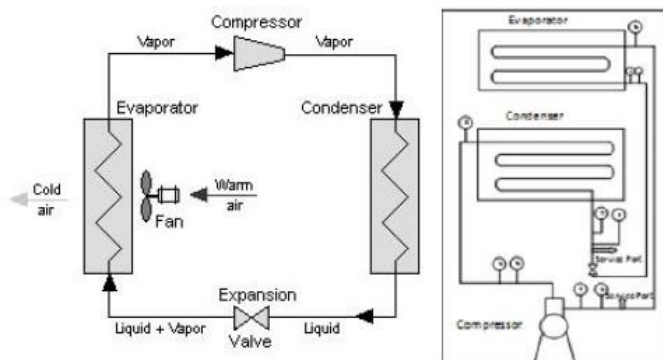


Fig 4. Schematic diagram of the investigation unit and apparatus

The trial arrangement of the family fridge utilized in the examination is appeared in Fig.4. The homegrown cooler comprises of an evaporator, wire network air-cooled condenser and airtight fixed responding blower. The 165 liters homegrown cooler of tropical class initially intended to work with HFC134a was taken for this investigation. The fridge was instrumented with one pressing factor check at the delta of the blower for estimating the attractions pressure, one temperature sensor mounted at inside the (cooler) compartment. According to the fridge produces proposal amount of charge prerequisite for HFC134a was 100 g. In the investigation, refrigerant charge is 10% higher because of the presence of instruments and interfacing lines and so on To enhance the blended refrigerant charge, the cooler is accused of 80g. The fridge was accused of 110 g of HFC134a and the gauge execution was contemplated. Subsequent to finishing the benchmark test with HFC134a, the refrigerant was recuperated from the framework and accused of 80g of blended refrigerant and the presentation was considered. The refrigerant accuse prerequisite of hydrocarbons is little because of their higher inactive warmth of vaporization. During the experimentation the air is kept up at  $28 \pm 2^{\circ}\text{C}$ . The trial strategies were rehashed and take the perusing from the different methods of various stacking conditions. Uncommonly, we direct the examination is absolutely founded on the vegetable and chicken in 0.5 and 1 kg load factor. Administration port is introduced at the channel of development valve and blower for charging and recuperating the refrigerant is appeared in Figure 4. Advanced Temperature Indicator was utilized to gauge within cooler temperature for this examination.

##### 4.2 Benefits

- Utilization of LPG as a refrigerant additionally improves the general effectiveness of by 10 to 20%.
- The ozone consumption potential (ODP) of LPG is 0 and Global warming potential (GWP) is 8 which is essentially immaterial as contrast with another refrigerant.
- Apart from climate agreeable, utilization of LPG likewise gives us part of cost benefits.
- There is 60% decrease in weight of the framework because of higher thickness of LPG.
- This cooler works when power is off.
- The parts are viably quiet in activity.
- Running expense is zero.
- Eliminates the blower and condenser.

##### 4.3 Disservices

- Efficiency is poor.
- Leakage of LPG causes the impact.
- Repairing and overhauling of the framework is troublesome.
- System is massive.

## 5. CONCLUSION

In LPG refrigeration, LPG gases from the chamber are utilized for the refrigeration impact. At the point when the LPG gas is delivered pressure drop happens and the heaviness of the gas decline. Because of the pressing factor drop cooling impact creates. A LPG chamber comprises of pressing factor 12.41 bar and a load of 14.5 kg outfitted with a high pressing factor controller. The pressure inside the cylinder is then reduced to 1.41bar with capillary tube. The refrigerating impact changes in properties of LPG when the evaporator, with the assistance of high pressing factor controller. In this way as an end we can utilize LPG as refrigerant in refrigeration framework. LPG won't hurt the eco framework. The capability of ozone layer exhaustion and a worldwide temperature alteration will be decreased because of use of current refrigerant in the homegrown refrigerators.

## REFERENCES

- [1] B. A.Akash, S.A. Said, Assessment of LPG as a possible alternative to R-12 in domestic refrigerators. *Energy conversion and Management* 44 (2003) 381-388.
- [2] R. Radermacher, K. Kim, Domestic refrigerator: recent development, *International journal of refrigeration* 19(1996) 61-69.
- [3] Prashant Sharma, - Design of capillary expansion device used in vapour compression refrigeration system. [IJLRST](2012).
- [4] Mohd. Aasim Nazeer Ahmad, - Experimental analysis of refrigerator by replacing conventional HFC refrigerants with hydrocarbons.[IOSR- JMCE] (2014).
- [5] N. Austin, - Thermodynamic optimization of household refrigerator using propane – butane as mixed refrigerant.[IJERA](2012).
- [6] Sethu Satyan, Gopakumar M.G. "Design of LPG Refrigeration system". *IJRSET*, volume 7, issue 5, May 2018. DOI:10.15680/IJRSET.2018.0705054
- [7] Zainal Zakaria, - The possibility of using LPG in domestic refrigeration systems. [IJRRAS](2011).
- [8] Dr. Kuldeep Ojha, - Analysis of modern eco-friendly refrigerant. [IJET](2013)
- [9] Prof.S. Mahajan, - A review of an alternative to R134a refrigerant in domestic refrigerator. [IJETAE](2013)