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Model of LPG Refrigerator: A Literature Review

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Abstract— *This work investigates the result of an experimental study carried out to determine the Coefficient of performance of domestic refrigerator when a propane-butane mixture is liquefied petroleum gas (LPG) which is available and comprises 56.4% butane, 24.4%propane, and 17.2% isobutene. This paper also presented an experimental investigation of COP by the effect of changing capillary tube length, capillary tube inner diameter and capillary coil diameter on the mass flow rate of refrigerant in an adiabatic helical capillary tube. Large amount of electricity supply is not available easily in large part of underdevelopment country like India. It will also prove to be an effective for remote area such as research sites, mines, & deserts where electricity is generally not available. The LPG is cheaper and possesses an environmental free in nature with no ozone depletion potential (ODP). Also LPG is available as a side product in local refineries. The results of the present work indicate the successful use of this propane-butane mixture as an alternative refrigerant to CFCs and HFCs in domestic refrigerator. It would include Experimental setup of working model and detailed observation of the LPG refrigerator and represents its application in refinery, hotel, chemical industries where requirement of LPG is more. Keywords: LPG refrigerator, domestic refrigerator, eco friendly refrigerants, Mixed Refrigerant.*

Keywords— LPG refrigerator, evaporator, zero cost refrigerators, electricity free refrigerator.

I. INTRODUCTION

The energy crisis persists all across the globe. We think of recovering the energy which is already spent but not being utilized further, to overcome this crisis with no huge investment. The climatic change and global warming demand accessible and affordable cooling systems in the form of refrigerators and air conditioners. Annually billions of dollars are spent in serving this purpose. Henceforth, we suggest NO COST Cooling Systems Petroleum gas is stored in liquefied state before its utilization as fuel. The energy spent for pressurizing and liquefying is not recovered afterwards. If it is expanded in an evaporator, it will get vaporized and absorb heat to produce cooling. This property has been used for refrigeration and air conditioning. So that the liquefied form of LPG can be used for cooling and the expanded gas (LPG) can be further used for combustion as a fuel. The ozone depletion potentials (ODPs) of HFC-134a relative to CFC-11are very low (<5 · 10_4), the global warming potentials (GWPs) are extremely high (GWP¼1300) For this reason, the production and use of HFC-134a will be terminated in the near future. The applications of new refrigerant mixtures to replace conventional refrigerants in domestic refrigerators have been studied by a number of researchers. Jung and Radermacher [3] performed a computer Simulations of single evaporate or domestic refrigerators charged with many pure and mixed refrigerants. The study attempted to find the best potential replacement for CFC- 12. James and Missenden [2] studied the use of propane in domestic refrigerators. Energy consumption, compressor lubrication, costs, availability, environmental factory and safety were the criteria for investigation. The results revealed that propane showed as an attractive alternative to CFC-12. Richardson and Butterworth [2] determined the performance of a vapor compression refrigeration system working with propane and a mixture of propane and isobutane. The obtained performance was higher than that obtained from CFC-12under the similar experimental conditions. Alsaad and Hammad [10] investigated experimentally the refrigeration capacity, compressor power and coefficient of performance (COP) to determine the performance of a medium size CFC- 12domestic refrigerator working with a propane/butane mixture. The results indicated the successful application of the mixture of propane and butane for their placement of CFC-12 in domestic refrigerators. Jung et al. [6] examined the performance of a mixture of propane and isobutane used in refrigerators. A thermodynamic analysis showed that the coefficient of performance of the system was increased up to 2.3% as compared toCFC-12 when the test was run at a mass fraction of propane ranging between 0.2and 0.6. Tashtoush et al. [4] presented an experimental study on the performance of domestic vapor compression refrigerators

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with new hydrocarbon/hydrofluorocarbon mixtures as refrigerants for the replacement of CFC-12. The results revealed that a mixture of butane, propane and HFC-134a gave excellent performance. Lee and Su [15] conducted an experimental study on the use of isobutane in a domestic refrigerator.

The results showed that the coefficient of performance was comparable with those obtained when CFC-12 and HCFC-22were used as refrigerants.LPG consists mainly of propane(R-290) and butane (R-600), and LPG is available as a side product in local refineries. In Cuba for already several decades LPG is used as a drop-in refrigerant. LPG mixtures have composition of a commercial LPG mixture suitable as „drop-in" replacement for R-12was calculated crudely as 64% propane and 36% butane by mass. Liquefied petroleum gas (LPG) of 60% propane and40% commercial butane has been tested as a drop-in suitable for R 134a in a single evaporator domestic refrigerator with a total volume of 10 ft3.In march 1989, the Institute of Hygiene in Dortmund Germany needed anew cold storage room. The young idealistic director, Dr Harry Rosin, could not consider using a CFC refrigerant and so tried propane and isobutane. Greenpeace Australia imported a For on refrigerator in February 1993 and in December 1993 Email Ltd, Australia "slargest appliance manufacturer, displayed prototype LPG refrigerators. In 1994, German manufacturer announced one by one their intention of switch to LPG refrigerants. The US EPA may not approve this either but OZ"s petition (OZ 1994) is convincing, comprehensive and technically sound especially on safety. Calor released Care 30 in June 1994. Care 30 is a high purity mixture of R-290 and R-600a and is a drop- in replacement for R-12 and R134a. it has been very successful in vehicle refrigeration and air-conditioning.

II. CONSTRUCTION

The LPG refrigerator shown in figure. We have made the one box of the Plywood. The plywood sheet size is 12mm for used the LPG refrigerator. The size of the refrigerator is 255*200*115 mm3.The evaporator is fitted in the box inside. Inside the refrigerator, we also put the Thermo-coal sheet. Because of the cold air cannot the transfer from inside to outside Of refrigerator. The schematically diagram of the LPG refrigeration system is shown in next page. The gas tank is connected by pipes to the Capillary tube. The capillary tube is fitted with evaporator. The evaporator coiled end is connected to the stove by another gas Circulation pipe. When two pressure gauges is put between capillary tube and gas tank, and another is put the end of the Evaporator

III. WORKING OF LPG REFRIGERATOR

The basic idea behind LPG refrigeration is to use the evaporation of a LPG to absorb heat. The simple mechanism of the LPG refrigeration working is shown in figure.LPG is stored under high pressure in LPG cylinder. When the regulator of gas cylinder is opened then high pressure LPG passes in gas pipe. This LPG is going by high pressure gas pipe in capillary tube .High pressure LPG is converted in low pressure at capillary tube with enthalpy remains constant. After capillary tube, low pressure LPG is passed through evaporator.LPG is converted into low pressure and temperature vapour form and passing through the evaporator which absorbed heat from the chamber. Thus the chamber becomes cooled down. Thus we can achieve cooling effect in refrigerator. After passing through evaporator low pressure LPG is passed through pipe by burner and we can use low pressure of LPG is burning process.

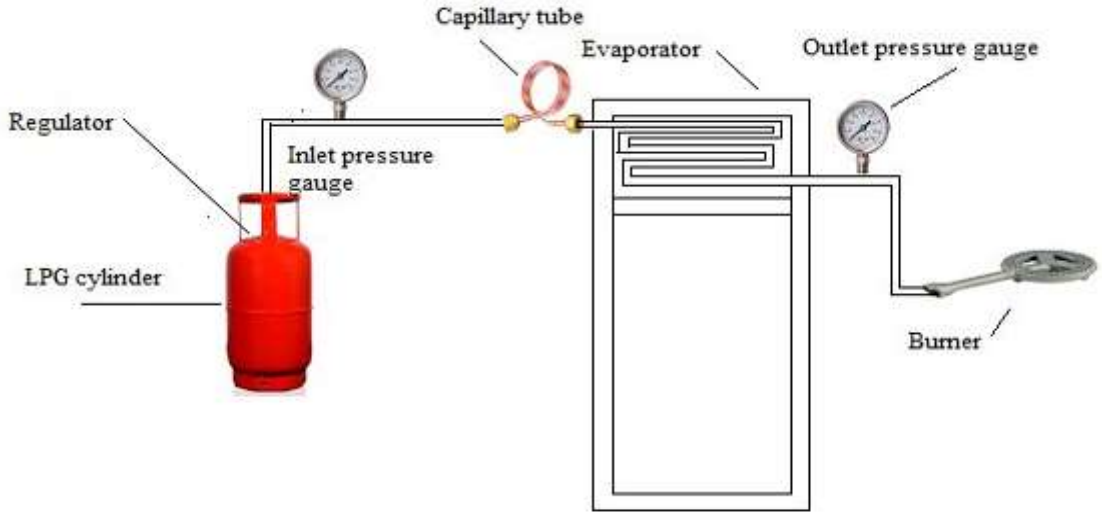

Fig.1: Working of LPG Refrigerator

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IV. LITERATURE REVIEW

ALTERNATIVE REFRIGERANTS TO R134A SYSTEM

[1].A.Baskaran&P.Koshy Mathews

A Performance Comparison of Vapour Compression Refrigeration System Using Eco Friendly. Refrigerants of Low Global Warming Potential VCR system with the new R290/R600a refrigerant mixture as a substitute refrigerant forCFC12 and HFC 134a. The refrigerantR290/R600a had a refrigerating capacity28.6% to 87.2% higher than that ofR134a.

[2].A.Baskaran&P.Koshy Mathews

A Performance Comparison of Vapour Compression Refrigeration System Using Eco Friendly Refrigerants of Low Global Warming Potential.R600a have a slightly higher performance coefficient(COP) thanR134a for the condensation temperature of 50 C^0 and evaporating temperatures ranging between -30 C^0 and10^{0}C.Hence,The coefficient performance (COP) of this mixture was up to 5.7% higher.

[3].M.Mohanrajet. al.

Have studied experimentally the drop in substitute forR134a with the environment friendly, energy efficient hydrocarbon (HC) mixture which consists of 45% HC290and 55% R600a at various mass charges of 50g, 70g and 90g in domestic refrigerator. The experiments were carried out in 165 liters domestic refrigerator using R134a with POE oil as lubricant. The power consumption of HC mixture at 50g and 70g are lower by 10.2% and 5.1% respectively and90g shows higher power consumption by 1.01%. The percentage reduction in pull down time is 18.36%, 21.76% and28.57% for 50, 70 and 90g mass2870charges respectively when compared toR134a. The HC mixture because of its high energy efficiency will also reduce the indirect global warming. In conclusion HC mixture of 70g is found to be an effective alternative to R134a in 165 liters domestic refrigerator.

[4]. B.O.Bolaji

Have Experimental study of R152a/R32 to replace R134a in a domestic refrigerator and find out that COP obtained by R152a is 4.7%higher than that of R134a. COP of R32is 8.5% lower than that of R134a and propane is an attractive and environmentally friendly alternative to CFCs used currently

[5]. R.W.James&J.F.Missenden

Have use of propane in domestic refrigerators and conclude that the implications of using propane in domestic refrigerators are examined in relation to energy consumption, compressor lubrication, costs, availability, environmental factors and safety propane is an attractive and environmentally friendly alternative to cfcs used currently.

[6]. Bilal A. Akashet. al.

Has conducted performance tests on the performance of liquefied petroleum gas (LPG) as a possible substitute for R12in domestic refrigerators. The refrigerator which is initially design to work with R12 is used to conduct the experiment for LPG (30% propane, 55%N-butane and 15% isobutane). Various mass charges of 50, 80 and 100g of LPG were used during theexperimentation.LPG compares very well to R12. The COP was higher for all mass charges at evaporator temperatures lower than −15˚C. Overall, it was found that at 80g charge, LPG had the best results when used in this refrigerator. The condenser was kept at a constant temperature of 47˚C.Cooling capacities were obtained and they were in the order of about three to fourfold higher for LPG than those forR12.

[7].M. Fatouhet. al.

Investigated substitute for R134a in a single evaporator domestic refrigerator with a total volume of 0.283 m3 with Liquefied petroleum gas (LPG) of 60% propane and 40% commercial butane. The performance of the refrigerator, tests were conducted with different capillary lengths and different charges of R134aand LPG. Experimental results of the refrigerator using LPG of 60g and capillary tube length of 5 m were compared with those using R134a of100g and capillary tube length of 4 m. Pull-down time, pressure ratio and power Consumption of LPG refrigerator were lower than those of R134a by about7.6%, 5.5% and 4.3%, respectively. COP of LPG refrigerator was 7.6% higher than that of R134a. Lower on-time ratio and energy consumption of LPG refrigerator was lower than 14.3% and 10.8%, respectively, compared to R134a. In conclusion, the proposed LPG is dropping in replacement for R134a, to have the better performance, optimization of capillary length and refrigerant charge was needed.

[8]. M.A.Hammadet.al.

Has experimentally investigated the performance parameters of a domestic refrigerator with four proportions ofR290, R600 and R600a are used as possible alternative replacements to theR12.An unmodified R12 domestic refrigerator was charged and tested with each of the four hydrocarbon mixtures that consist of 100% R290,75%R290/19.1%R600/5.9%R600a,50%R290/38.3% R600/11.7%R600a and25%R290/ 57.5%R600/17.5% R600a. The results show that the hydrocarbon mixture with

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50%R290/ 38.3%R600/11.7%R600a is the most suitable alternative refrigerant which has COP which is 2.7% higher than the R12.

[9]. Somchai Wongwiseset. al.
Has conducted to substitute R134a in a domestic refrigerator with hydrocarbon Mixtures of R290,R600 and R600a. A239 liter capacity refrigerator initially designed to work with R134a was chosen in the experiment. The experiments are conducted with the refrigerants under the same no load condition at a surrounding temperature of 25˚C. The results show that 60%R290/40%R600 is the most suitable alternative refrigerant to R134a.

[10]. Sanjeevsinghpunia&Jagdev Singh
Have Experimental investigation on the performance of coiled adiabatic capillary tube with lpg as refrigerant and conclude that There was an increase in mass flow rate by 106%, When the capillary inner diameter was increased from 1.12mm to 1.52mm.When the coil diameter of capillary tube was decreased from 190mm to 70mm, the mass flow rate was decreased by13%, 7% and 9% for 1.12mm, 1.4mmand 1.52mm inner diameter of capillary Tube respectively. 1.40 mm diameter capillary affected the system more as compared to 1.12 mm diameter capillary tube. Mass flow rate increases with increase in capillary inner diameter and coil diameter where as mass flow rate decreases with increase in length. It was observed that the COP of system increases with similar change in geometry of capillary tube.

V. CONCLUSION

Finding from literature we conclude that:

- Propane is an attractive and environmentally friendly alternative to CFCs used currently.
- Mass flow rate increases with increase in capillary inner diameter rand coil diameter where as mass flow rate decreases with increase in length. It was observed that the COP of system increases with similar change in geometry of capillary tube.
- The coefficient of performance of refrigeration appliances improves in case of retrofitting the capillary tube.
- Cooling capacities were obtained order of about three- to four fold higher for LPG than those for R-12.
- COP of LPG refrigerator was higher than that of R134a by about7.6%. LPG seems to be an appropriate long-term candidate toreplaceR134a in the existing refrigerator,
- High COP values were obtained No operation problems have been encountered compressor. The use of LPG as a replacement refrigerant can contribute to the solution of (ODP) problem and global warming potential.
- It seems that propane/butane60%/40% is the most appropriate alternative refrigerant to HFC-134a.

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