A REVIEW ON WORKING OF LPG REFRIGERATOR

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ABSTRACT

Supply of continuous electricity is still not available in several areas of the country and the world. At such places, this work will be helpful for refrigeration of food, medicines, etc. This paper investigate the results of experimental study carried out to determine the performance of domestic refrigerator when a liquefied petroleum gas (LPG) which is locally available which comprises of 24.4% propane,56.4% butane and 17.2% isobutene which is varied from company to company is used as a refrigerant. The LPG is cheaper and possesses and environmental friendly nature with no ozone depletion potential (ODP) and no Global warming potential (GWP). It is used in world for cooking purposes. The refrigerator used in the present study is designed to work on LPG. The performance parameters investigated is the refrigeration effect in certain time. The refrigerator works efficiently when works on LPG instead of R134a. The use of LPG for refrigeration purpose can be environment friendly since it has no ozone depletion potential (ODP).

The various methods of refrigeration on the basis of standard refrigeration discussed. The refrigerator used in present study is of medium size with gross capacity of 125 liter and is designed to work on LPG. The performance parameters investigated is the refrigeration effect in some specified time. The refrigerator works efficiently when LPG was used as refrigerant instead of CFC12. The evaporator temperature reached -5 degree centigrade with an ambient temperature of 12 degree centigrade. Also from the experiment which is done in atmospheric condition, we can predict the optimum value of cooling effect with the suitable operating condition of regulating valve and capillary tube of the system. The results of the present work indicate the successful use of the propane-butane mixture as an alternative refrigerant to CFC12 in domestic refrigerant.

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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-11 are 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 simulation of

single evaporator 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 factors 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 isobutene. The obtained performance was higher than that obtained from CFC-12 under 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- 12 domestic refrigerator working with a propane-butane mixture. The results indicated the successful application of the mixture of propane and butane for the replacement of CFC-12 in domestic refrigerators. Jung et al. [6] examined the performance of a mixture of propane and isobutene used in refrigerators. A thermodynamic analysis showed that the coefficient of performance of the system was increased up to 2.3% as compared to CFC-12 when the test was run at a mass fraction of propane ranging between 0.2 and 0.6. Tashtoush et al. [4] presented an experimental study on the performance of domestic vapor compression refrigerators with new hydrocarbon/hydro fluorocarbon 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 isobutene in a domestic refrigerator. The results showed that the coefficient of performance was comparable with those obtained when CFC-12 and HCFC-22 were 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-12 was calculated crudely as 64% propane and 36% butane by mass. Liquefied petroleum gas (LPG) of 60% propane and 40% commercial butane has been tested as a drop-in suitable for R 134a in a singleevaporator domestic refrigerator with a total volume of 10 ft3.

In March 1989, the Institute of Hygiene in Dortmund Germany needed a new cold storage room. The young idealistic director, Dr Harry Rosin, could not consider using a CFC refrigerant and so tried propane and isobutene. Greenpeace Australia imported a Forum refrigerator in February 1993 and in December 1993 Email Ltd, Australia's largest appliance manufacturer, displayed prototype LPG refrigerators. In 1994, German manufacturer announced one by one their intention of switch to LPG refrigerants.

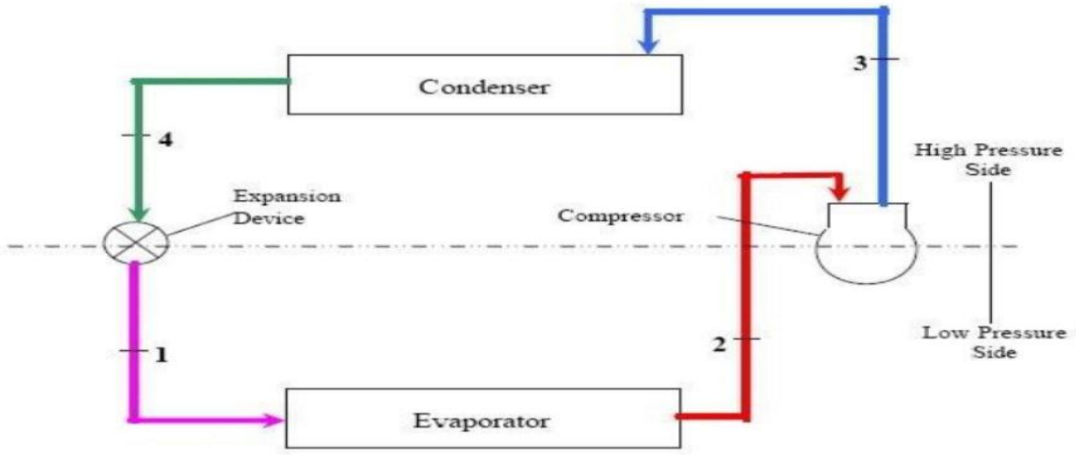

Fig. (1): Schematic diagram of simple VCRS

WORKING DIAGRAM

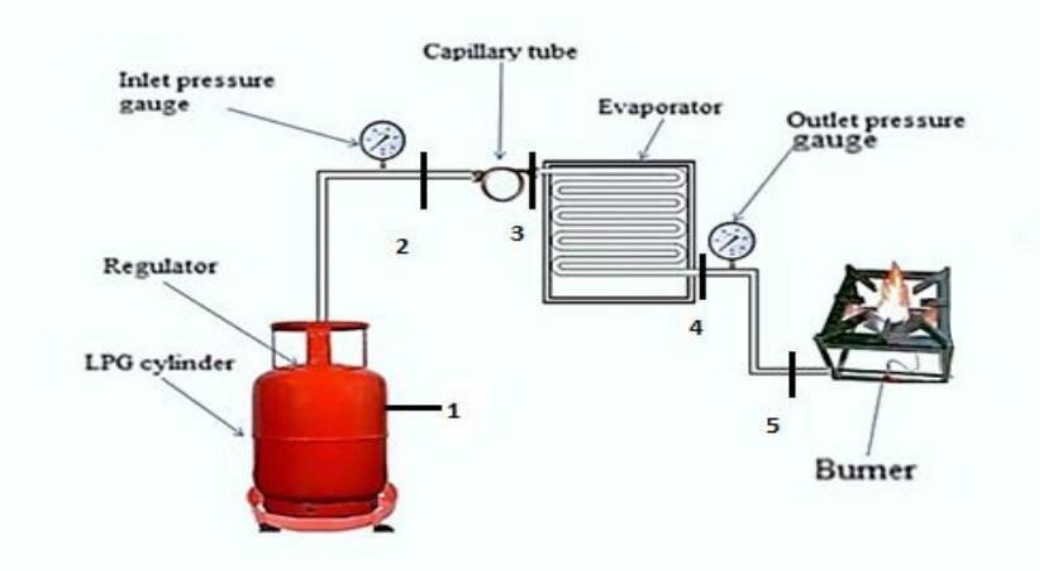

Fig. (2): Working of LPG Refrigerator

LITRATURE REVIEW

A.Baskaran & P.Koshy Mathews:- A Performance Comparison of Vapor Compression Refrigeration System Using Eco Friendly. Refrigerants of Low Global Warming Potential VCR system with the new R290/R600a refrigerant mixture a substitute refrigerant for CFC12 and HFC 134a. The refrigerant R290/R600a had a refrigerating capacity 28.6% to 87.2% higher than that of R134a.

A.Baskaran & P.Koshy Mathews:- A Performance Comparison of Vapor Compression Refrigeration System Using Eco Friendly Refrigerants of Low Global Warming Potential. R600a have a slightly higher performance coefficient(COP) than R134a 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.

M.Mohanraj et. Al.:- Have studied experimentally the drop in substitute for R134a with the environment friendly, energy efficient hydrocarbon (HC) mixture which consists of 45% HC290 and 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 discharge temperatures of HC mixtures are found to be lower than R134a by 13.76%, 6.42% and 3.66% for 50g, 70g and 90g respectively. The power consumption of HC mixture at 50g and 70g are lower by 10.2% and 5.1% respectively and 90g shows higher power consumption by 1.01%. The percentage reduction in pull down time is 18.36%, 21.76% and 28.57% for 50, 70 and 90g mass charges respectively when compared to R134a. 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.

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 R32 is 8.5% lower than that of R134a and propane is an attractive and environmentally friendly alternative to CFCs used currently.

R.W.James & J.F.Missenden:- Have use of propane in domestic refrigerators and conclude that he 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.

Bilal A. Akash et. Al:- Has conducted performance tests on the performance of liquefied petroleum gas (LPG) as a possible substitute for R12 in domestic refrigerators. The refrigerator which is initially designed 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 the experimentation. 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 for R12.

M. Fatouh et. 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 differentcharges of R134a and LPG.

CONCLUSIONS

Finally 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 and coil diameter, 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 thecapillary tube.
- Cooling capacities were obtained order of about three- to fourfold higher for LPG than thosefor R- 12.
- COP of LPG refrigerator was higher than that of R134a by about 7.6%. LPG seems to be an appropriate long-term candidate to replace R134a in the existing refrigerator, except capillary tube length and initial charge.
- 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/butane 60%/40% is the most appropriate alternative refrigerant to HFC-134a.

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