EVOLUTION OF DOMESTIC REFRIGERATOR BY USING LPG AS REFRIGERANT

A Review

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***ABSTRACT*:** This paper presents an experimental study of LPG environment-friendly refrigerants with zero ozone depletion potential (ODP) and negligible 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 LPG 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 Organisation (ISO) for small refrigerator were achieved earlier using refrigerant LPG and R134a than using R32. The average coefficient of performance (COP) obtained using LPG is 4.7% higher than that of R134a while average COP of R32 is 8.5% lower than that of R134a. The system consumed less energy when LPG was used. The performance of LPG in the domestic refrigerator was constantly better than those of R134a and R32 throughout all the operating conditions, which shows that LPG can be used as replacement for R134a in domestic refrigerator.

KEYWORDS*: Lpg refrigerant, capillary tube, length, Evaporator, Cop, Vapour compression cycle*

INTRODUCTION

Refrigerator was one of the best inventions of 21st century. It uses cooling effect which is referred as Refrigeration, Refrigeration, it is a process of removal of heat from a body. which means cooling of that body. This also helps in reducing and maintaining the temperature of a body below the surrounding temperature and it is a continuous process. vapour-compression refrigeration is a cycle which uses to remove heat from the body and maintain a temperature below the atmospheric temperature.

When mechanical refrigeration was first developed, the most commonly used refrigerants were ammonia, carbon dioxide,sulphur dioxide and methyl chloride. All these refrigerants were found to be toxic or hazardous. However, in 1931 a safer alternative became available with the introduction of chlorofluorocarbons(CFCs) and hydrochlorofluorocarbons (HCFCs) Results from many researches show that ozone layer is being depleted due to the presence of chlorine in the stratosphere. The general consensus for the cause of this is that CFCs and HCFCs are large class of chlorine containing chemicals, which migrate to the stratosphere where they react with ozone. And later, chlorine atoms continue to convert more ozone to oxygen. The discovery of the depletion of the earth's ozone layer, which shields the earth's surface from UV radiation, has resulted in a series of internationaltreaties demanding a gradual phase out of halogenated fluids. The CFCs have been banned in developed countries since 1996, and in 2010, producing and using of CFCs will be prohibited completely in all over the world. Also, the partially halogenated HCFCs are bound to be prohibited in the near future.

2.1 LITERATURE SURVEY :

Akintunde et al. [1] In the vent of chlorofluorocarbons (CFCs) phase-out, identify long term alternative to meet requirements in respect of system performance and service is an important area of research in the refrigeration and are conditioning industry. This work

focuses on experimental study of the performance of eco-friendly refrigerant mixtures. Mixtures of three existing refrigerants namely: R600a (n-butane), R134a (1,1, 1,2,tetrafluoroethane) and R406A (55%R22/4%R600a/41%R142b)were considered for this research. These refrigerants were mixed in various ratios, studied and compared with R-12 (dichlorodifluoromethane) which was used as the control for the experimentation. The results show that R134a/R600a mixture in the ratio 50:50 can be used as alternative to R-12 in domestic refrigerators, without the necessity of changing the compressor lubricating oil. At and , R-12 gives a COP of 2.08 while 50:50 blend of R134a/R600a gives a COP of 2.30 under the same operating conditions. B.O. Bolaji [2] This paper presents an experimental study of LPG and R32, environment-friendly refrigerants with zero ozone depletion potential (ODP) and low global warming potential (GWP), to replace R134a in domestic refrigerator.The results obtained showed that the design temperature and pull-down time set by International Standard Organisation (ISO) for small refrigerator were achieved earlier using refrigerant LPG and R134a than using R32. The average coefficient of performance (COP) obtained using LPG is 4.7% higher than that of R134a while average COP of R32 is 8.5% lower than that of R134a. I. L. Maclaine-cross E. Leonardi [3] This paper shows the Ozone depletion and global warming require replacement of chlorofluo- rocarbon refrigerantslike R12. The hydrofluorocarbonR134a is nonflammable, difficult to synthesize, has zero ozone depletion and high global warming.LPG refrigerants are highly flammable, occur naturally, have zero ozone depletion and negligible global warming. Sumeet Prakash Baviskar, Ajinkya Prabhakar Bairagi [4] Study of instantaneous cooling effect on water using LPG gas as a refrigerant in today's life. A refrigerators serves many and useful purposes such as cooling water, storing food items, medicines, beverages, and other such materials.It is cheaper and eco-friendly towards global warming. It works efficiently when used instead of R134a to obtain good cooling effect and this may be a small step towards power saving, supporting towards environment. P. Sarat Babu, Prof. N. Hari Babu [5] In his experimental work, it is proposed to optimize condenser length for domestic refrigerator of 165 litres capacity. It may give a chance to find a different length other than existing length will give better performance and concluded that the optimum length of coil is 7.01m. NeerajUpadhyay [6] This Paper Presents The Concept Of Analytical Study Ofvapour Compression Refrigeration System Using Diffuser And Subcoolingmainly Carried Out To Improve The Coefficient Of Performance Of System. To Improve The Coefficient Of Performance, It Is To Required That Compressor Work Should Decrease And Refrigerating Effect Should Increase. Dheeraj et al. [7] This paper investigates the impact of flash chamber on the performance of household refrigerators. In this novel flash chamber concept, the liquid and vapour is segregated before entering the evaporator which results in improvement in the coefficient of performance of the system. Shoyab hussan [8] his aim is to improve the coefficient of performance of system which is based on vapor compression cycle. To improve the coefficient of performance, its requires that the compressor work should decrease and refrigeration effect should increase. It means that decrease in condenser pressure and temperature so the refrigeration effect will increase. Sukani Sunny [9] The main objective is to improve performance of the refrigeration system in term of refrigeration Capacity, Compressor work and Coefficient of performance (COP) by determining three important parameters during in operating mode which are temperature, pressure and refrigerator flow rate. M.M. Nasr, M. Salah Hassan [10] In this study, an innovative, evaporative condenser for residential refrigerator was introduced. The experimental results showed that the condenser temperature increases 0.45 -C for each degree increase in evaporator temperature when the air velocity is 2.5 m/s, and the ambient condition is 29 -C. Damola S. Adelekana et al. [11] This article present an experimental investigation of varied mass charges of Liquefied Petroleum Gas (40 g, 50 g, 60 g and 70 g) enhanced with varied TiO2 nanoparticle/mineral oil.At 70 g of LPG using 0.6 g/L concentration of nano-lubricant, highest cooling capacity index of 65 W was obtained while the highest COP of 2.8 was obtained with 40 g charge of LPG using 0.4 g/L concentration of nanolubricant. C S Choudharia, S N Sapalib [12] This paper analyzes the possibilities of R290 as a potential substitute to R22.Thermodynamic performance analysis of refrigerants R290 and R22 was carried out.Performance parameters like, discharge temperature, volumetric refrigerating capacity and required mass flow of refrigerant were found to be lower with R290 when compared to R22. Overall, R290 can be a better substitute to R22 in real applications because of its excellent environmental and thermo-physical properties. M. Fatouh, M. El Kafafy [13] This paper shows the Continuous running and cycling tests were performed on that refrigerator under tropical conditions using different capillary tube lengths and various charges of R134a and LPG. It was found that LPG with capillary tube lengths from 4.0 to 6.0 and charge of 50 g or more satisfy the required freezer air temperature of -12 -C. J.K. Guptaa, M. Ram Gopalb [14] The study shows that the aluminum tape used to stick the condensing tube to the outer sheet plays a significant role in heat transfer from condenser to environment. ZHANG Huiyong et al. [15] This paper introduces a microchannel condenser for domestic refrigerators with a theoretical model to evaluate its performance. The results show that the needed tube height of the downward section decreases with the number of tubes and the tube diameter. Bilal A. Akash, Salem A. Said [16] In this paper, experimental results on the performance of liquefied petroleum gas (LPG) as a possible substitute for refrigerant R-12 in domestic refrigerators are presented. The results show that LPG

compares very well to R-12. Mohamed El-Morsi [17] In this study, three different pure HCs propane (R290), butane (R600) and commercial LPG (liquefied petroleum gas) are used in the theoretical analysis. R134a is also used in the analysis as a reference refrigerant. LPG has the advantage of being not expensive, available in large amounts and zero ozone depletion potential and low global warming potential. M.A. Alsaad, M.A. Hammad [18] This work investigates the result of an experimental study 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 CFC 12. Naser R. M. AL-Ajmi [19] this paper presents an experimental investigation of the performance of the refrigeration cycles.The evaporator load effects on the machine performance, where the COP of the machine increases with the increase of the evaporator load. T.S. Ge et al. [20] their results show that with use of an auxiliary SHE, the temperature variable rate increases obviously, meanwhile about 4oC lower outlet temperature can be obtained, the corresponding cooling power and COP increase by about 75% and 13% respectively. Deokate S.M. et al [21] Domestic refrigerators consume approximately 17,500 metric tons of traditional refrigerants such as Chlorofluorocarbon (CFC) and Hydrofluorocarbon (HFC) every year which contribute to very high Ozone Depletion Potential (ODP) and Global Warming Potential (GWP).This paper deals with the study of Refrigeration with LPG as a refrigerant, the properties of LPG and its comparison with the other refrigerants. Jatinder Gill, Jagdev Singh [22] This study deals with predicting the mass flow rate of R134a/LPG as refrigerant inside a straight and helical coiled adiabatic capillary tube of Vapour compression refrigeration. experimental results shows that Compared to the mass flow rate of R134a/LPG as refrigerant in straight capillary tube, mass flow rate in the helically coiled capillary tube with a coil diameter of 60, 90 and 120 mm reduced by an average of 16, 12 and 5%. Muji Setiyo et al [23] This paper presents a new concept for air-conditioning systems in Liquefied Petroleum Gas (LPG) fuelled vehicles, a ½ cycle refrigeration system. The test results show that the actual cooling effect produced is as high as 1.2 kW for a LPG flow rate of more than 3 g/s and an air mass flow rate of 16 g/s. J.M. Belman-Flores, A. Gallegos-Muñoz [24] This work presents the analysis of the flow and thermal behavior of the compartment in a refrigerator. Ibrahim Hussain Shah, Mohammad Shoeb Sheikh [25] this study gave the potential how to use the LPG in refrigerator and also studied the load of Air Conditioner on an automobile engine and their effects on tail pipe emissions and fuel efficiency. So studies shows that LPG can be used in a car air conditioner as a refrigerant and as a fuel for an automobile engine we designed a system which works on LPG as a refrigerant and a fuel for an automobile engine. Anil S.Katarkar, Lenin Dhale [26] This paper describes the construction and testing of an integrated heat recovery system which has been designed both to enhance the performance of a domestic refrigerator. This paper also showed that the thermodynamic properties associated with the relative increase in refrigerating effect, i.e. liquid specific heat and latent heat of vaporization, are dominant to determine the maximum COP improvement. Jianlin Yu, Zhenxing Du [27] In this paper, a transcritical ejector refrigeration cycle (TERC) using refrigerant R143a as working fluid is proposed to improve the performance of the ejector refrigeration systems. The results show that when utilizing the low-grade thermal energy, the TERC yields significant increase in COP.

CONCLUSION:

- Hence we conclude that LPG refrigerant as zero ODP and negligible GWP.
- LPG when use in refrigerator can also be used as cooking fuel for domestic appliances
- It has relatively, high COP values were obtained which can be favourably compared with those of CFC 12.
- The use of LPG as a replacement refrigerant can contribute to the solution of ozone depletion problem and global warming potential.
- The higher the evaporator vapor pressure in the evaporator and the greater the mass flow rate of LPG, the greater the cooling effect produced.

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