Review Study on Low Cost Refrigerator by Using LPG as Refrigerant

Shiv Prasad[1] Shalini Chauhan[2]
[1]Student [2]Assistant Professor
[1,2]Department of Mechanical Engineering
[1,2]Dev Bhoomi Institute of Technology, Dehradun, Uttarakhand, India

Abstract— Supply of continuous electricity is still not available in several areas of the country and the world and refrigerator consuming more electricity. So we need an alternative refrigerant for refrigeration. Domestic refrigerator consume approximately 17500 tons 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). Hence LPG as refrigerant can be a better alternative. LPG comprises of 24.4% propane, 56.4% butane and 17.2% isobutane. The LPG for refrigeration purpose can be eco-friendly and it has no ozone depeletion potential (ODP). This paper deal with the study of refrigeration with LPG as a refrigerant, the properties of LPG and its compression with the other refrigerant.

Keywords: LPG Refrigerant, Refrigerating Effect, Temperature Effect, ODP, COP

I. INTRODUCTION

The term 'refrigeration' in a broad sense used for the process of removing heat from a substance. It also includes the process of reducing and maintaining the temperature of the body below the general temperature of the surrounding. According to the Government of India, the refrigerator is the 3rd heaviest consumer of power among household application. It is one of the appliances that is running 365 days in year. In earlier days, ethyl chloride was used as a refrigerant which soon gave way to ammonia as early as in 1875. At about the same time, sulphur dioxide in 1874, methyl chloride in 1878 and carbon dioxide in 1881, found application as refrigerant. During 1910-30 many new refrigerants, such as N2O3, CH4, C2H6, C2H4, C3H8 were employed for medium and low temperature refrigeration. A great break through occur in the field of refrigeration with the development of freons. Freon are a series of fluorinated hydrocarbon, generally known as fluorocarbons, derived from methane, ethane, etc., as bases. Presently, the most commonly used organic refrigerant are the choloro-fluro derivatives of CH4 and C2H6. But all these refrigerants are highly costly and have high power consumption rate and high globe l warming potential(ODP). Therefore LPG is better alternative refrigerant instead of these refrigerant. The working principle of LPG refrigeration system is during the conversion of LPG into gaseous form the expansion process will be take place. Due to this expansion in LPG gas the pressure will drops. And the volume will be increase this will be result into dropped in temperature and we get cooling effect hence LPG acts as refrigerant. Therefore LPG is expected to result in comparable product efficiencies based on its properties and characteristics.

II. LITERATURE REVIEW

A. Baskaran & P. Koshy Mathews [1] have performance Comparison of Vapour Compression Refrigeration System Using Eco Friendly Refrigerants of Low Global Warming Potential. R600a performance have a slightly higher (COP) than R134a for the condensation temperature of 50 C^0 and evaporating temperatures ranging between -30 C^0 and10^0.

Bilal A. Akash, Saleem A Said [2] conduct 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). Cooling capacities were obtained and they were in the order of about three to fourfold higher for LPG than those for R12**.**

R. W. James & J. F. Missenden [3] perform Implications of using propane in domestic refrigerators are examined in relation consumption, compressor costs, availability, to energy lubrication, environmental factors and safety propane is an attractive and environmentally friendly alternative to CFCs used currently.

N. Austin, Dr.P. Senthil Kumar, N, (2012) [4] have performed experiments on house hold refrigerator designed to work with R134a. The recital of the refrigerator using mixed refrigerant was investigated and compared with the performance of refrigerator when R-134a was used as refrigerant. The energy consumption of the refrigerator during experiment with mixed refrigerant and R-134a was measured. The outcome shows the permanent running and cycling results showed that R134a with a charge of 100 g or mixed refrigerant with charge of 80 mg or more satisfy the required freezer air temperature of −12 °C. The lowest electric energy consumption was achieved using mixed refrigerant with heat level is less than -15oC. This mixture achieved higher volumetric cooling capacity and lower freezer air temperature compared to R134a. And actual COP of mixed refrigerant refrigerator was higher than that of R134a by about 7.6%. From the experiment it was conclude the every mode of mixed refrigerant yields higher COP than HFC-134a. And the mixed refrigerant in domestic refrigerator the freezer temperature lower than that of R134a. And when the evaporator temperature increases, COP will be increase and the condenser temperature will decreases, COP will also increases.

NARALE P.D. (2017) [5] has perform comparison between LPG refrigeration system and CFC-22 refrigeration system. And detect various waste in domestic refrigeration system. They also compare the performance of LPG refrigeration system and domestic refrigeration system.

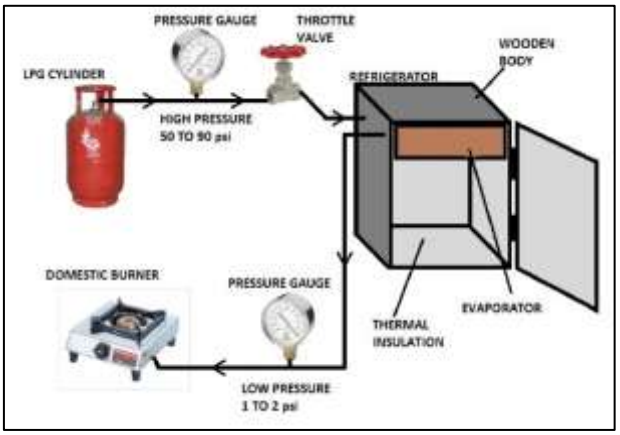

Fig. 1: Experimental setup of LPG refrigeration system [6] [Vishwadipsinh J.et.al 2013]

Vishwadipsinh J.[6] Ghariya has perform an experimental study on LPG refrigerator system and conculde that propane is an attractive and environmentally friendly alternative to CFCs used currently. COP of LPG refrigerator was higher than of R134a by about 7.6%.

A.S. Raut, U.S.Wankkhede[7], have worked on selection of capillary tube for Retrofittring in Refrigeration application and try to use of alternative refrigerant play an important role in forming problems such as globel warming and ozone depilation. The coefficient of performance of refrigeration application improve in case of retrofitting the capillary tube. It is possible to obtain effective size of capillary tube by using mathematical techniques and by maintaining proper pressure equalization between condenser and evaporator.

M. Rasti, M.S.Hatamipour, S.F. Aghamiri, M. Tavakoli[8] have investigate on Enhancement of domestic refrigerators energy efficiency index using hydrocarbon mixture refrigerant, and showed that R436A (admixture of R290 and R600a with a mass ratio of 56/44) in a 238 L single evaporator domestic refrigerator without any modification in refrigeration.

III. Construction of the LPG Refrigerator

We have made the one box of the plywood. The size of refrigerator is 405mm*350mm*400mm. The evaporator is fitted in the box inside. Inside the refrigerator, we also put the thermo-coal sheet, because of the cold air cannot transfer from inside to outside of refrigerator. The experimental setup of LPG refrigeration system is shown in fig.1.

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 is put between capillary tube and gas tank, and another is put the end of the evaporator.

IV. Working of LPG Refrigerator

The basic idea behind LPG refrigeration is to use the evaporation of a LPG to absorb heat. 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 remain constant.

V. Conclusion

From this above paper we conclude that LPG is better alternative refrigerant and eco-friendly than other refrigerant. It is studied that the evaporator temperature reached -20^{o}C with COP value of 6.4 and an ambient temperature of 30^{o}C. This system is cheaper in initial as well as running cost. It does not require any external energy sources to run the system and no moving part in the system so maintenance is also very low. This LPG refrigeration system has wide scale application in hotel industries, chemical industries, where LPG consumption is at higher level. The COP range of LPG refrigeration system is between 6 to 13 and it is better than other domestic refrigerator.

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[8] M. Rasti a, M.S.Hatamipour a, S.F. Aghamiri a, M. Tavakoli M. Tavakoli b. a Chem. Eng. Dept., University of Isfahan, Isfahan, Islamic Republic of Iran bR&D Dept., Entekhab Industrial Group, Isfahan, Islamic Republic of Iran.

