International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 06 | June - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

LOW-COST OPERATING LPG REFRIGERATOR SYSTEM

Anand Chaugule[1], Gopal boinwad[2], Chaitanya Patale[3], Sagar Jankar[4], Dr. S.V. Eklarkar[5]

[1] *UG Student, Dept. of mechanical, Dbatu University, Karmayogi Institute of Technology, Pandharpu, Maharashtra*

[2] *Professor Dept. of mechanical, Dbatu University, Karmayogi Institute of Technology, Pandharpur, Maharashtra*

Abstract -*The study explores the use of liquefied petroleum gas (LPG) as a refrigerant in domestic refrigerators to provide continuous refrigeration in areas without steady electricity supply. LPG, consisting of propane, butane, and isobutene, is cost-effective and environmentally friendly with no Ozone Depletion Potential or Global Warming Potential. The experiment compared the performance of an LPG-based refrigerator to one using R134a, finding LPG to be more efficient. By analyzing the refrigeration effect over time, the study determined the optimum cooling effect based on valve and capillary tube settings. LPG undergoes a phase change in the capillary tube, resulting in a drop in pressure and temperature, allowing it to produce a refrigerating effect. The Coefficient of Performance (COP) of an LPG refrigerator was found to be higher than a traditional refrigerator. Overall, using LPG as a refrigerant in refrigerators can be a sustainable and environmentally friendly solution for regions with unreliable electricity access.*

Key Words: **LPG, REFRIGERATOR, REFRIGERANT, OZONE DEPLETION POTENTIAL.**

1.INTRODUCTION

The novel refrigeration system introduced utilizes the expansion of LPG (liquefied petroleum gas) to create a cooling effect as a sustainable alternative to traditional refrigerants that contribute to global warming. It works on the principle of LPG expansion, leading to a drop in temperature for refrigeration purposes. Unlike traditional refrigerators that require electrical power, this system harnesses the expansion of LPG for cooling, offering a potentially more energy-efficient solution. It emphasizes the importance of refrigeration in various industries beyond household kitchens, such as food processing and cold storage. The system's simplicity lies in passing high-pressure LPG through a capillary tube to generate the desired refrigerating effect, addressing environmental concerns by replacing harmful refrigerants with LPG for a lower environmental impact.

1.1 LITERATURE SURVEY

A study compared the performance of a Vapour Compression Refrigeration (VCR) system using eco-friendly refrigerants with low global warming potential. The R290/R600a refrigerant mixture was found to have higher refrigerating capacity compared to R134a. The study suggests the use of propane in domestic refrigerators as an environmentally friendly alternative to current refrigerants. Additionally, R600a was found to have a slightly higher performance coefficient (COP) than R134a under certain temperature conditions.

2. DESIGN OF BASIC COMPONENTS OF LPG REFRIGERATION SYSTEM

The capillary tube is a crucial component in a refrigeration system, acting as a fixed restriction-type device. It connects the condenser directly to the evaporator, with pressure drop occurring due to friction and acceleration factors.

The design parameters for the capillary tube include a cylinder size of 14 kg, a cylinder diameter of 295 mm, and a capillary tube diameter of 1.05 mm. The evaporator, on the other hand, removes heat from air, water, or other bodies by evaporating the refrigerant. In an experimental setup, a plate and tube type evaporator is used for gentle evaporation, minimal residence time, and low installation cost.

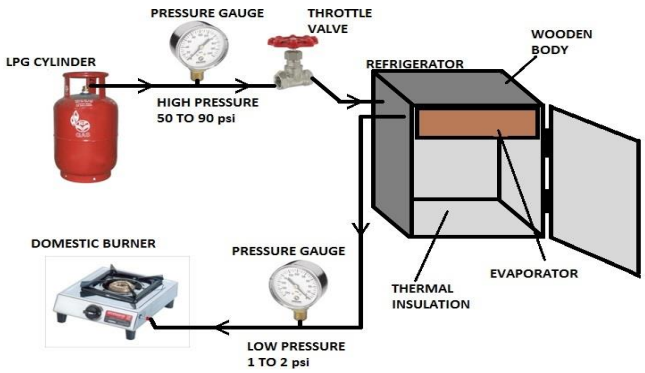

Fig -1: LPG refrigeration and heating system

Fig -2: Setup of LPG Refrigeration

3. PARTS OF LPG REFRIGERATION:

LPG is a mixture of butane and isobutene stored at 12.7 bar in household cylinders for various purposes. It is sent into capillary tubes using regulators for use in domestic, industrial, horticultural, agricultural, cooking, heating, and drying processes. LPG can also be used as automotive fuel or propellant for aerosols with specialist applications, including providing lighting through pressure lanterns.

The capillary tube is a copper tube of small diameter coiled to minimize space, used as a throttling device in domestic refrigeration systems. It plays a crucial role in reducing pressure of the refrigerant for efficient cooling.

Evaporators are important components in refrigeration systems that produce the cooling effect by transferring heat from the substance to be cooled to the refrigerant.

Pressure gauges and vacuum gauges are used to measure pressure in various applications.

High pressure pipes are used to transfer gas at high pressure, with steel balls fitted at both ends for sealing against gas leakage.

High pressure regulators are specifically used to send high-pressure gas from cylinders, often for functions such as Bhatti stoves.

4. WORKING PRINCIPLE OF LPG REFRIGERATOR

The working of an LPG refrigerator is based on the principle of using LPG to absorb heat and provide cooling. The LPG is stored in a cylinder under high pressure and is passed through a high-pressure pipe to a capillary tube where it is converted to low pressure and temperature vapor. This vapor then passes through the evaporator, where it absorbs heat from the chamber, resulting in the cooling effect.

The Vapour Compression Refrigeration (VCR) system in the LPG refrigerator works by compressing the low-pressure vapor from the evaporator to a high pressure, converting it into a liquid. The liquid is then passed through a control valve to reduce pressure and temperature, turning it back into vapor before entering the evaporator again. This process allows for the absorption of heat from the cooling chamber, completing the refrigeration cycle.

The overall idea behind LPG refrigeration is to lower the pressure of the LPG stored in the cylinder by using a capillary tube, which results in a cooling effect through the absorption of heat from the surroundings. The high-pressure LPG is converted into low pressure and temperature vapor, which can then be utilized for cooling purposes in the refrigerator. Additionally, the low-pressure LPG can also be used for burning in other applications.

In the LPG refrigeration system, a recompressed LPG cylinder is used instead of a traditional compressor to achieve the desired refrigeration effect. The setup and construction of the LPG refrigerator system are essential for understanding the working principles behind it.

5. CONCLUSIONS

The goal of using LPG as a refrigerant is to utilize the high pressure in the cylinder to produce a refrigerating effect in refrigeration systems. The pressure in a domestic 14.5 kg cylinder with a high-pressure regulator is reduced using a capillary tube, from 12.41 bar to 1.41 bar. It is important to use a high-pressure regulator instead of a low-pressure regulator typically used in residential LPG gas stoves to maintain the pressure of LPG for optimal refrigeration performance.

The system is cost-effective, with low maintenance and operational costs, making it suitable for areas with high LPG consumption like hotels, refineries, and chemical companies. Propane is a sustainable alternative to CFCs commonly used in refrigeration systems, showing improved performance in terms of cooling capabilities and coefficient of performance (COP) compared to other refrigerants like R-12 and R134a. The use of LPG as a refrigerant can help address environmental concerns related to global warming potential and ozone depletion potential.

6. REFERENCES

[1] A Textbook of Refrigeration And Air Conditioning By R.S. Khurmi, S. Chand Publication.

[2] “PCRA energy audit report”, HPCL LPG bottling plant Asauda Bahadurgarh (Haryana) Dec. 2006.

[3] “Basic statics on Indian petroleum and natural gas” 2006-07.

[4] Shank K. Wang, “Handbook of air conditioning and refrigeration” page no. 11.14 chapter 11.