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# THERMAL PERFORMANCE EVALUATION OF A LOW-COST LPG-BASED COOLING SYSTEM

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**ABSTRACT:** An LPG-powered refrigerator was constructed and put through its paces by our team as part of this research project. In certain cylinders of liquid petroleum gas (LPG), there is a significant amount of pressure. In the process of moving through a capillary tube with a very small inner diameter, this high-pressure LPG gas undergoes a phase transition that is isoenthalpic in nature. In turn, this results in the gas expanding, which in turn results in a decrease in pressure. As the temperature drops, the process of the liquid refrigerant converting into a gas leads in the formation of latent heat. This heat is responsible for the cooling process. Through the use of LPG, one can obtain a cooling effect.

***Keywords:*** *LPG Refrigeration system ,COP, VCR's, Refrigerating Effect, LPG.*

## I.INTRODUCTION

Incremental power outages persist in many parts of the globe, including the US. Using this method, perishable items like food and medicine will remain at a safe temperature for an extended period of time. The purpose of this research was to analyze the results of an experiment that tested the efficiency of a home refrigerator running on liquefied petroleum gas (LPG). Variations in propane, butane, and isobutene percentages in locally generated LPG refrigerant are observed across producers. Liquefied petroleum gas (LPG) is beneficial for both the environment and businesses due to its low GWP and ODP. All around the globe, people utilize it as a cooking tool.

A fridge that runs on liquid propane gas is utilized in this program. The fridge started working better when I switched out the R134a refrigerant for LPG. You may find out how effective the cooling will be by experimenting with different operational settings of the equipment's capillary tube and seeing how they react to different weather conditions. A more eco-friendly alternative is LPG refrigerant, which does not deplete ozone. The cooking fuel of choice in many households, restaurants, and hotels is liquefied petroleum

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gas (LPG). The combustion of LPG gas produces CO2 and water vapour as waste products. The refrigerator in this project was designed to use LPG as its refrigerant.

**AIM AND OBJECTIVES**

**Aim:**An LPG-powered refrigeration system, rather than an electrical one, is what we need.

**Objectives:**An investigation on the potential benefits of using an LPG-powered refrigerator at home.

- To analyze the key points shared by conventional refrigeration systems and those that use liquefied petroleum gas (LPG).
- To determine the discrepancy between the expected and actual costs of an LPG refrigerator.
- To evaluate the efficiency of a standard refrigerator and an LPG refrigerator side by side.

## II. LITERATURE REVIEW

**Research performed by Prof. Sushant S. Bhansali, 2018**

A fuel for burners and a coolant for air conditioners, LPG is made by the company. Because it is convenient and easy to transport, an air conditioner that employed LPG as its refrigerant underwent performance testing. Potentially eco-friendly is the use of LPG for refrigeration. Cooking with LPG is common in many establishments, including households, restaurants, and hotels. The combination of LPG and a fan makes it an effective air conditioner for smaller rooms. According to his findings, the coefficient of performance (COP) of an LPG refrigerator was higher than that of a standard residential refrigerator.

**Research Performed by Mhaske M.S., 2016**

The purpose of the research is to determine how well an LPG-powered home refrigerator performs. A refrigerator was constructed and tested in this research using LPG as the refrigerant. Crypts are used to store LPG due of its high pressure. Phase changes of LPGs occur during isoenthalpic processes. This happens as the pressure drops because the compressed LPG gas expands as it travels down the capillary tube. Latent heat from evaporation is absorbed by the liquid refrigerant when its temperature decreases during the gasification process. This is the mechanism by which LPG achieves its cooling effect. The results demonstrated that the coefficient of performance (COP) was higher for an LPG refrigerator.

**Research Performed by Bilal A. Akash, 2002**

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Investigating the feasibility of using LPG as an alternative to R-12 in residential freezers is the focus of this research. Home refrigerators were originally intended to be used with the RR-12. Forty, eighty, and one hundred grams of liquid propane gas were required for the test. According to the findings, LPG is more effective than R-12. Evaporator temperatures below 15 °C resulted in an improvement of the coefficient of performance for all mass charges. When filled with 80 g of LPG, the refrigerator performed at its peak. The existence of collection capabilities has been noticed.

## III.WORKINGPRINCIPLE

The theory of the Vapour Compression Refrigeration System is the foundation of how an LPG refrigeration system operates. A VCR is seen in Figure 1. A standard Vapour Compression Refrigeration System consists of the following five components:

1. Compressor
2. Condenser
3. Receiver
4. ExpansionValve
5. Evaporator

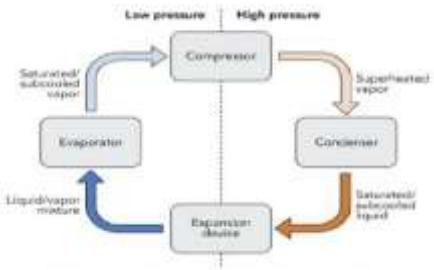


Figure1:VapourCompressionCycle

1. **Compressor:**Both the pressure and temperature of the refrigerant vapor are significantly increased when it is compressed in the evaporator.
2. **Compressor.**The highly pressurized and heated vapor refrigerant is collected by the condenser.
3. **Condenser:**A condenser is a device that uses coils to transform high-pressure, extremely hot gases into a liquid state.
4. **Expansion Valve (also known as the throttle valve):**Created to regulate the flow of liquid refrigerant in terms of both temperature and pressure; alternatively known as the throttle valve.
5. **Evaporator:**Coils in the evaporator facilitate the transformation of a liquid-vapor

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refrigerant into a vapor refrigerant upon cooling and pressure reduction.

## IV.ACTUAL SETUP WORKING

Evaporation of liquid propane gas (LPG) is the primary mechanism by which an LPG refrigeration system removes heat from the surrounding air. The LPG refrigerant is maintained at a pressure of approximately 80 psi by means of the cylinder. The LPG pressure was reduced to 15 to 20 psi through capillary action, allowing the surrounding space to absorb the heat more easily.

Turning on the regulator causes the highly pressurized LPG refrigerant to flow into the gas line from the LPG gas cylinder. Afterwards, the capillary tube is supplied with high-pressure LPG through the high-pressure conduit. There is no change to the enthalpy as the LPG moves from a high-pressure to a low-pressure oscillatory state in the capillary tube. Refrigerant with low pressure is then introduced to the evaporator. The LPG refrigerant draws heat out of the evaporator and pumps chilly air into the chamber simultaneously. The outcome is a decrease in temperature within the cold storage area.

Figure2:LPGRefrigerationSystem

Everything is therefore made colder by the refrigerator. The low-pressure LPG refrigerant is transported to the burner by a high-pressure pipe, and it is then burned and put to various uses. This design utilizes a cylinder for recompressed LPG gas instead of a compressor. Things get cooler with this tactic. Figures 2 and 3 illustrate this phenomenon.

Figure 3: LPG Refrigerator

The pressurized cylinder stores LPG, or liquefied petroleum gas. As soon as the regulator

opens, the high-pressure conduit is filled with LPG. The next step is to connect the pressure conduit to the capillary tube.

The conversion of high-pressure LPG to low-pressure LPG is accomplished by maintaining the same enthalpy in the capillary tube.

The LPG refrigerant is within the evaporator, which is presently operating under low pressure.

Evaporators are used to store liquefied petroleum gas (LPG) vapors, which are low-pressure and low-temperature. They absorb the heat from the room and turn it into vapour. As a result, the temperature inside the chamber drops.

The fridge will begin to chill down after that.The pipe is used to transfer the low-pressure LPG to the burner once it has evaporated. All of our burning needs are met by this LPG, which is a low-pressure liquefied petroleum gas.

**ADVANTAGES**

- Liquefied petroleum gas (LPG) has the advantage of not adding to climate change or ozone depletion, unlike other refrigerants.
- Compared to the traditional refrigerants typically used in homes, LPG is both more cost-effective and better for the environment.
- The denser structure of LPG results in a 60% reduction in the system's weight.
- The power outage doesn't stop this refrigerator from working.
- The parts of a system don't make a sound when it's running.
- All costs are one-time.
- Compressor is not operating.

**DISADVANTAGES**

- The level of effectiveness is declining.
- The refrigeration system may require a considerable amount of time for maintenance and repairs.

**APPLICATION**

- Hotels and restaurants might benefit from keeping the temperature constant.
- The chemical industry uses it as a refrigerant.
- Employed in refineries that consume a substantial quantity of liquefied petroleum gas (LPG).
- Both commercial and household air conditioning and refrigeration systems can benefit from this technology.

- Vehicles that run on gasoline, like LPG, benefit greatly from its ability to cold.

## V.CONCLUSION

An LPG refrigeration system's primary function is to chill items by using LPG as a refrigerant. Gas cylinders used for residential use can withstand pressures of up to 12.14 bar. To go from the coldest to the warmest, we employed a capillary tube. Installation and maintenance expenses for an LPG refrigeration system are minimal. All of the system's power is generated internally. Additionally, the system's lack of rendering components results in reduced maintenance expenses. Hotels, restaurants, and chemical plants that consume a lot of LPG are perfect candidates for the LPG refrigeration system.

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