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PERFORMANCE EVOLUTION OF DOMESTIC REFRIGERATOR USING LPG CYLINDER

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ABSTRACT:
Many places in the nation and the world still lack a steady supply of electricity.This workwill be useful in these locations for the refrigeration of food, medications, etc.This study examines the findings of an experimental investigation conducted to ascertain the performance of a home refrigerator when a locally accessible liquefied petroleum gas (LPG)which varies from company to company in its composition of 24.4% propane, 56.4% butane, and 17.2% isobuteneis used as a Coolant. Because it has no global warming potential (GDP) or ozone depletion potential (ODP), LPG is more affordable and environmentally friendly.Around the world, people use it for cooking. In this research, we used LPG as the refrigerant and designed and analyzed a refrigerator.Because LPG has a high pressure, it is kept in cylinders. The pressurized LPG expands and undergoes an isenthalpic phase transition as it passes through the capillary tube with a tiny internal diameter, lowering the LPG pressure. The liquid refrigerant gains latent heat of evaporation as a result of the phase transition from liquid to gas, which lowers the temperature. LPG has the ability to cool the environment in this way. We have discovered via experimental research that an LPG refrigerator has a greater COP than a residential refrigerator.

1. INTRODUCTION:

Owing to the enormous global demand for power, we consider collecting energy that has previously been used but isn't being used any more in order to get through this crisis with fewer investment. The need for accessible and reasonably priced cooling devices, such as air conditioners and freezers, is a result of climate change and global warming. From now on, we recommend FREE cooling systems. Before being used as fuel, LPG is kept in a cylinder in a liquid condition. As per the energy report, one of the appliances that uses the most electricity is the refrigerator. customers in regard to home appliances. It operates under the premise that when liquid LPG is converted to gaseous form, LPG will expand. This causes the pressure of LPG gas to decrease and the volume of gas to increase, which in turn causes the temperature of the gas to decreasealso serving as a refrigerant. The second law of thermodynamics states that this cooling process can only be completed with outside assistance.Therefore, a power source is always needed to run a refrigerator.The material that transfers heat from a cold body to a hot bodythat is, the environmentin a refrigerator isknown as refrigerant.

The use of LPG instead of CFC 22 has improved environmental conditions since it has no ODP and is more environmentally friendly. Globally, domestic refrigeration uses 17500 metric tons of conventional refrigerants, such as CFC and HFC, which have high ozone depletion potential (ODP) and global warming potential (GWP).The usage of LPG produces good product efficiency due to its

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properties. It suggests that LPG is a viable substitute. Following running the test on the new system, switch the refrigerant to CFC 22.

2. OBJECTIVES:

The following are the goals for the project "Performance evolution of Refrigerator using LPG Cylinder":

• Determining the type of leftover waste in a conventional refrigeration system.
• Examine the key differences between standard refrigeration systems and LPG refrigeration systems.
• To distinguish between the current existing refrigerator cost and estimated cost of LPG refrigerator.

3. SCOPE OF WORK:

• In isolated areas without access to electricity, it may be helpful.
• It might be crucial in restaurants where there is a constant need for heating and cooling.
• It may be used for air conditioning in cars that operate on LPG or other gaseous fuels.

4. WORKING PRINCIPLE:

LPG evaporation is how the LPG refrigerator absorbs heat. LPG is kept under pressure in cylinders, typically at 80 psi.In order for the heat absorbed adiabatically from the refrigeration box and chilling, we are decreasing this pressure to 1 psiacquired in the environment. High pressure LPG is kept in the LPG cylinder. High pressure LPG travels through the gas line when the regulators' gas tank is opened.High pressure was applied on the capillary tube by this LPG. LPG at high pressure is changed to low pressure in a capillary tube while the enthalpy stays constant.LPG at low pressure is run through an evaporator. LPG passes through the evaporator and is transformed into low pressure, low temperature vapour. This takes in heat from the cooling unit. As a result, the refrigerated box cools. Thus, the refrigerator can have a cooling effect.The burner receives the LPG from the evaporator via a conduit.

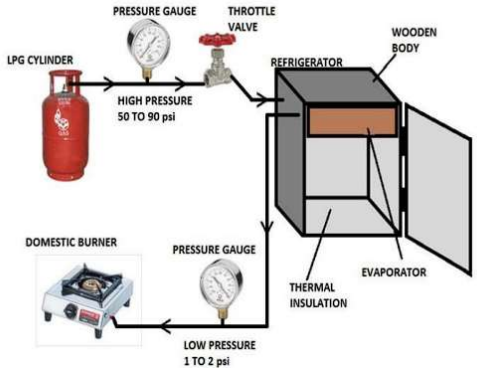

Figure.1.Schematic setup of LPG refrigeration system

5. Selection of Parts:

A. LPG Gas Cylinder:

Liquefied petroleum gas, or LPG, is mostly composed of butane (C4H10) and propane (0C3H8).These two are either mixed together or stored apart.These two are either mixed together or stored apart. LPG is a fuel that may be used for home, business, agriculture, heating, and cooking. procedures for drying. It may also be used as aerosol propellant or as fuel for automobiles.

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Figure.2.LPG Gas Cylinder

B. Evaporator:

Another crucial part of the refrigeration system is the evaporator. The refrigerant is passed through the evaporator coil to create the cooling effect. The refrigerant is passed through the evaporator coil to create the cooling effect. Heat is transferred from the material to the refrigerant by the evaporator. It indicates a heat exchanger function for the evaporator. As the water in this compartment freezes into ice, the evaporators serve as the freezer. At extremely low temperatures and pressures, the refrigerant is transferred through the capillary tube to the evaporators. This refrigerant absorbs heat from the substance that has to cool, causing the refrigerant to heat up as the substance cools down.

Figure.3. Evaporator

C. Capillary Tube:

Small internal diameter tubes are known as capillary tubes. There is a range of 0.5 to 2.28 mm in this diameter. Copper is the material used to make capillary tubes.The capillary tube's tiny diameter causes the refrigerant's pressure to decrease sharply as it enters. The capillary tube's width and length determine how much the refrigerant's pressure decreases as it passes through the capillary.

Figure.4. Capillary Tube

D. Pressure Gauge:

This device is used to measure the gas pressure. In this project, two different gauge typeshigh pressure and low pressureare used.The fluid whose pressure is to be measured is inside the tube. One end of the tube is fixed and another end is free to move inward or outward.

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Figure.5. Pressure Gauge

E. Burner:

After performing the cooling effect, low pressure LPG gas goes into the burner where theburns. As we know whenever the fluid flow through the narrow pipe there is a pressure drop. The amount of pressure drop in our system is calculated.

Figure.6. Burner

F. Temperature Meter:

A temperature meter is an instrument used to measure the temperature of beings or things. Themost widely recognized temperature meter is a mercury thermometer used to measure the temperature of people. These thermometers consist of a graduated glass capillary with a pool of mercury in one end.

Figure.7. Temperature Meter

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G. Gas Pipes:

The LPG is delivered from the cylinder at a very high pressure, hence high pressure pipes are required. It is made up of a steel pipe that has steel spheres fastened to both ends. With the aid of two swivelling nipples, these spheres are forced up against the seating of the connection hole, preventing gas leakage is avoided.

Figure.8. Gas Pipes

6. Experimental Setup:

The low-pressure LPG refrigerant flows through the evaporator after the tube. The capillary tube translated into the capillary tube through the LPG. The LPG is transformed into small pressure vapour and processes to the evaporator that absorbs heat in the chamber, making it comfortable and cooling the refrigerant. The LPG passes through the pipe to burner after passing through the evaporator. The VCR system goes as follows.

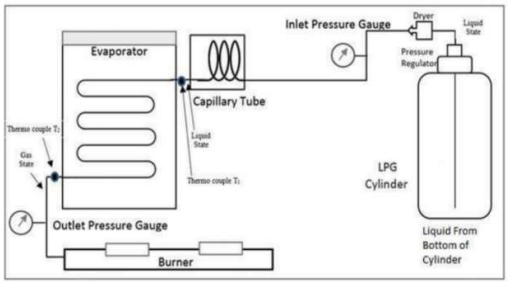

Figure.9. Block Diagram of LPG Refrigerator

7. Actual Setup:

Thegascylinderisconnectedtohighpressureregulator,whichisconnectedtohighpressurepipes.Totheother endofthe high-pressure pipes pressure gauge is connected. To another end a copper tube isconnected which is connected to the capillary tube. The capillary tube is fitted withevaporator. The evaporator coil end is connected to the stove by another high-pressurepipe. One pressure gauge is put between capillary tube and cylinder and another is putatthe end ofthe evaporator.

Figure.10. Actual Setup

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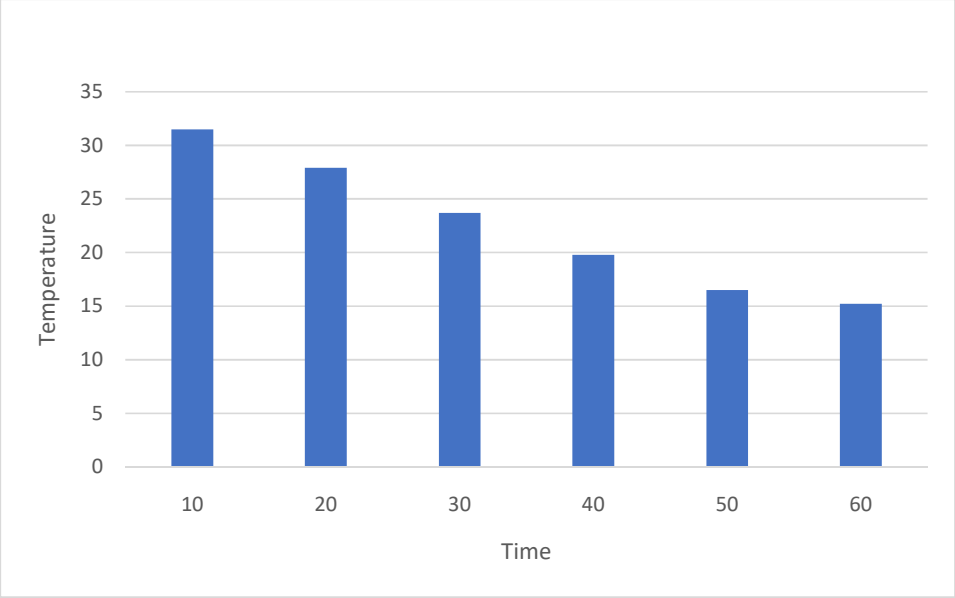
8. Experimental Readings:

8.1 Table Readings:

In the experimental reading inlet pressure gives the pressure at inlet, outlet pressure gives the pressure at outlet. This experiment is taken in a time interval of 10 min. Capillary. Evaporator temperature gives the temperature inside evaporator. We conducted this experiment on 16th March 2024, and the readings were taken at 10 minute's intervals, for 1hr which is as shown in table 1

InletPressure (Bar)	OutletPressure (Bar)	Time (Min)	Temperature (˚C)
5.525	0.698	10	33.5
5.235	0.665	20	27.9
5.403	0.645	30	23.7
5.413	0.645	40	19.8
5.556	0.645	50	16.5
5.511	0.645	60	15.2

Table.1. Experimental Readings



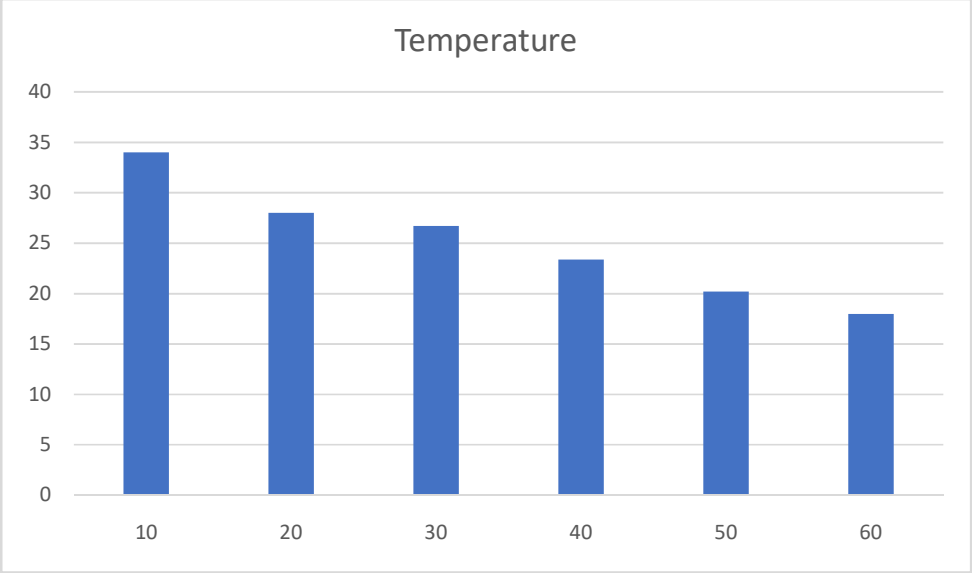
Graph.1. Temperature vs Time for 1st Experimental Readings

Again, we conducted this experiment on 19th March 2024, and the readings were taken at 10 minute's intervals,with same cylinder for 1 hour which is as shown in table 2 below:

InletPressure (Bar)	OutletPressure (Bar)	Time (Min)	Temperature (˚C)
5.510	0.702	10	34

5.445	0.688	20	28
5.365	0.654	30	26.7
5.401	0.668	40	23.4
5.420	0.648	50	20.2
5.430	0.648	60	18

Table.2. Experimental Readings



Graph.1. Temperature vs Time for 1st Experimental Readings

9. ADVANTAGES OF LPG REFRIGERATION:

1. Since there are no moving parts in the system, there is no noise or vibration.
2. An energy-saving system is one that uses the same energy source for both burning and refrigeration processes.
3. It is capable of operating on waste heat.
4. Because energy is not used, the system is power-saving.

10. APPLICATIONS OF LPG REFRIGERATION:

1. It can have a significant impact on restaurants that need to continually heat and chill.
2. In isolated areas without access to power, it may be helpful.
3. It may be applied in refineries with heavy LPG usage.
4. The system is widely applicable to residential refrigeration and air conditioning, as well as industrial central cooling.
5. It may be utilized for free air conditioning in places with their own gas turbine power plants, such as shopping centres and airports.

11. CONCLUSION:

From the experiment we have conclude that the high-pressure LPG gas stored in a cylinder at 5.525 bar equipped with a high-pressure regulator. when LPG gas released the pressure drop occurs and the weight decrease. With the help of capillary tube, the pressure will drop down to the 1 bar from the operational pressure 5.25 bar. Due to the pressure drop the refrigerating effect occurs in an evaporator. The refrigerating effect changes the properties of LPG before and after evaporator. Therefor a conclusion we can use LPG as a refrigerant in a refrigeration. LPG will not harm the environment and the eco system. The potential of ozone layer depletion and global warming will be reduced due to usage of current refrigerant in a domestic refrigerator. As per the experimental readings (table: -1) we conclude that the evaporator temperature reduces 33.5 ˚c to 15.2 ˚c at loading condition in 60 mins. As per the experimental readings (table: -2) we conclude that the evaporator temperature reduces 34 ˚c to 18 ˚c at loading condition in 60 mins. As per the above paragraph the cooling effect of LPG refrigeration varies with the load and pressure. So that the design of the refrigerator is different cooling load under the different pressure. From this temperature drop we can say that the refrigerating effect is higher than the other domestic refrigerator. Eliminates the Compressor and condenser we can conclude that the COP is higher than the other domestic refrigerator.

12.FUTURE SCOPE:

It is anticipated that a new product will be introduced in the refrigeration industry and that it will perform well in conjunction with current products. The primary goal is to concentrate on the school lunch program, community program hall, and restaurant in order to conserve food items like milk and vegetables.Additionally, for small snack shops, lowering the refrigerator's weight increases the likelihood that it will work, eliminating the compressor entirely, and maximizing cost savings because refrigeration is not necessary.

The technology may be further enhanced and used to automobiles that utilize LPG as a fuel for air conditioning.

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