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LPG as an Unconventional Refrigerant for Refrigeration

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***Abstract*— Need of air conditioning is increasing day by day. Many types of air conditioners are present in market. Some of them are working on electricity. But continuous supply of electricity is still not available in several areas and some of them are working on coolants like R134a, R12 and refrigerants such as CFC and HFC which contributes every year to very high ozone depletion and global warming. In our system, LPG is use as coolant for air conditioning system which contains a combination of propane, isobutene and high amount of butane. The use of LPG for a refrigeration purpose can be eco-friendly since it has negligible ozone depletion potential. In this project we use properties of LPG for air conditioning in domestic as well as automotive application by circulated with pressure difference through copper coils, situated in insulated casing. Results showed that the percentage of CFC and HFC completely eliminated.**

***Keywords*— LPG Refrigerant, refrigeration effect, copper coil.**

INTRODUCTION

Day by day the climatic change and global warming demand accessible and affordable cooling system in the form of refrigerators and air conditioners. Annually lots of money is spent in serving this purpose. Hence we invent this low cost cooling system according to second law of thermodynamics; heat is a virtually being pump from lower temperature to higher temperature by adding some of external work.

The system which we are introducing to you is totally depends upon atmospheric air and liquefied petroleum gas. It works on the principle that during the conversion of LPG into gaseous form the expansion will take place due to this expansion there is a pressure drop and increase in volume of LPG that results in a drop of temperature and due to that refrigerating effect is produce. These properties are used for refrigeration and air conditioning. So that the liquefied form of LPG is used for cooling and the expanded gas is further used for combustion as a fuel.

Components used for system design

There are four parts in this system are:

1. Copper coil: - It is spiral type structure in which the LPG gas is flow through inlet to outlet for generating the air conditioning effect. Reason for using copper coil is, its good heat transfer capacity as well as good corrosion resistance, cheaper in cost.

2. Glass wool: - It is an insulating material made from fibers of glass arranges using a binder into a texture similar to wool. The small pockets present in glass wool results in high thermal insulation properties. It is used in casing for maintaining the inner temperature.

3. Metallic casing: - casing is a made up of AISI1018 mild/ low carbon steel, because it has excellent weld ability and produce a uniform and harder case. It offers a good balance of toughness, strength and ductility.

4. Blower: - it is used for ventilation purpose.

5. Gas cylinder

LITERATURE REVIEW

1. M. Mohanrajet. al.

Have studied experimentally the drop in substitute for R134a with the environment friendly, energy efficient hydrocarbon(HC) mixture which consist of 45% HC 290 and 55% R600 at a various mass charges of 50gram, 70 gram and 90 gram in domestic refrigerator. The experiment where carried out in 165liters domestic refrigerator using R134a with POE oil as a lubricant. The power consumption of HC mixture at 50gram and 70 gram are lower by 10.2 and 5.1 respectively and 90gram shows higher power consumption by 1.01 %. The percentage reduction in pull down time is 18.36 %, 21.76% and 28.57% for 50, 70 and 90grams mass 2870 charges respectively when compared to R134a the HC mixture because of its high energy efficiency will also reduce the indirect global warming. In conclusion HC mixture of 70gram is found to be an effective alternative to R134a in 165litre domestic refrigerator.

2. Bilal A. Akashet. al.

Has conducted performance test on the performance of liquefied petroleum gas (LPG) as a possible substitute for R12 in domestic refrigerator. The refrigerator which is initially designed to work with R12 is use to conduct the experiment for LPG (30% propene, 55% N-Butene and 15% isobutene) various mass charges of 50, 80 and 100gram of LPG where used during the experimentation. LPG compares very well to R12. The COP was higher for all mass charges at evaporated temperature lower than -15℃. Overall, it was found that at 80gram charge, LPG had the best result when used in this refrigerator. The condenser was kept at a constant temperature

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of 47°C. Cooling capacities where obtain and they were in the order of about three two, four fold higher than LPG than those for R12

3. B.O. Balaji

Have experimental study of R152a/ R32 to replace R134a in a domestic refrigerator and find out that COP obtains by R152a is 4.7% higher than that of R134. COP of R132 is 8.5% lower than that of R134a and propane is attractive and environment friendly alternative to CFCs use currently.

4. R.W. James and J.F. Missenden

Have use of propane in a domestic refrigerators and conclude that the implications of using propane in domestic refrigerators are examine in relation to energy consumption, compressor lubrication, cost, availability, environmental factor and safety propane is an attractive and environmental friendly alternative CFCS use currently.

NEED TO BE DESIGN

This system is used to reduce pollution which creates by domestic and car AC. In car applications, to reduce the load on engine shaft replaces the existing AC.

It is a system which partially independent on electricity, hence it is different from existing system.

WORKING

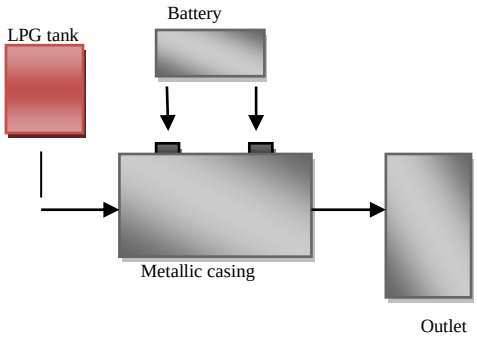

Figure no. 1

LPG is used as an alternative fuel in buildings, hotels and cars. It is compressed at high pressure in compressor. At a compressed level LPG gets liquefied and cools down at a low pressure. The temperature of this liquefied is around 0-5 °C. Such temperature can be used as coolant in refrigeration i.e. air conditioning. In a normal air conditioner the coolant is flow through coil which exchanges the heat and provides cold air in the surrounding.

In the following system the liquefied LPG will be used as heat exchanger

Temp °C	Pressure (KPA)	Pressure (Bar)
43	1358	13.6
38	1186	11.9
32	1027	10.3
27	883	808
16	637	604
-1	356	306
-18	152	1.5
-29	74	0.7
-43	0	0

Table no.1, LPG pressure chart

First of all LPG regulator is used to reduce and maintain the safe operating pressure. When the regulator gets open the gas enters at low pressure and low temperature in copper coil through gas pipe. Copper coils exchange the heat from LPG gas to atmospheric air. Then the LPG gas is passing to the engine/burner (outlet) and we get low temperature air, at air outlet for room/car.

WORKING DIAGRAM

Figure no.2, experimental setup

RESULTS

Sr. No.	Atmospheric temperature °C	Inlet temperature °C	Outlet temperature °C	Time min
1	36	36	32	15
2	36	36	30	20
3	36	36	26	25
4	36	36	21	30
5	36	36	18	35

Table. No. 2, result table

Gas flow rate :

Time required gaining 18°C temp.
1st atmospheric inlet temperature (t1) =36°C
Required temperature =18°C
At 0sec temperature=36°C

After 35min temperature =18°C
Time required to gain 18°C= 35min

Time required for gas to flow through the tube
Area =1000cm^3
Volume of tube=1 litre
Pressure of gas= 1.5-2 bar
Time required to pass the LPG gas through 1000cm^3 area is 5-10sec
For burning it required 15-20sec at 1.5 bar

Calculations for gas
I. Required gas to fill the copper coil or tube=0.91kg
II. Total amount of gas=3kg=3.29litre
III. Total time burn 3kg gas=7hrs

To calculate gas used for achieving 18°C temp. Within 35min

Total amount of gas ÷ time required to burn total gas
3kg ÷ 7hrs=0.4285kg/hr

To calculate gas required for 1min.
$0.4285 \div 60 = 7.14285 * 10^{-3}$ --- (1)

With the help of above equation (1) we can calculate the total gas required to obtain 18°C temperature

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1 min = $7.14285*10^{-3}$ kg gas used to obtain 18℃ temperature therefore for 35min = $7.14285*10^{-3}$ *35=0.249 kg or 249 gram Therefore 0.249 kg or 249 gram gas required to obtain 18 ℃ temperatures.

sr. no.	Amount of gas (kg)	Time required to burn it (min)
1	3	420
2	0.42815	60
3	0.24995	35
4	$7.14166*10^{-3}$	1

Table no. 3

As per experiment 0.24991 kg gas is required to cool 1m^3 area.

Sr. no.	Area (m^3)	Gas required (kg)
1	1	0.24991
2	2	0.49982
3	3	0.74973
4	4	0.999
5	5	1.24

Table no. 4, gas required

CONCLUSION

We can conclude that this system will provide air conditioning effect within very cheaper rate than other existing syste

This system is environmental friendly and pollution free.

A general AC system emits CFC which depletes the ozone layer, these harmful effects gets remove by using of our system.
This system has low maintenance cost.

Also this system is implemented in a common gas system where the large amount of gas is for cocking in buildings and hotels.
This system can be implemented in every LPG vehicle; hence we can reduce the engine shaft load and increase some amount of mileage.

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