Non Conventional Cooling System with LPG

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Abstract

A non-conventional cooling system uses LPG (Liquefied Petroleum Gas as Refrigerant). Domestic refrigerator which containing chlorine or fluorine item which is ban by international law due to ozone layer depletion and global warming problem. This work enables to boost the calorific value of gas by ensuring the vapor gas is going to burner. This project works on simple vapor compression refrigeration cycle. The vapor compression refrigeration cycle consists of compressor, condenser, capillary tube & evaporator. The compressor whose function is to increase pressure and temperature of vapor refrigerant and condenser is used for condensation of high temperature and high pressure vapor. These cycles are replaced by LPG cylinder i.e. (LPG cylinder has compressed & condensed refrigerant init).

The LPG cylinder work as compressor and condenser. The high pressure LPG is passing through refrigeration circuit in which it passes through expansion valve or capillary tube & loop of evaporator. Due to it the latent heat of Liquefied Petroleum Gas gets converted from liquid to vapor which is called latent heat of evaporation of LPG. The cooling effect is obtained by using this latent heat of LPG in evaporator. Hence only vapor is supplied to the burner.

Keywords*: - LPG Cylinder, Capillary Tube, Evaporator, Digital Thermometer, Burner.*

INTRODUCTION

The non-conventional Refrigeration System works on latent heat of vaporization of liquefied petroleum gas. This project gives output free of cost; it requires only the refrigeration circuit for getting cooling effect. The refrigeration circuit in non-conventional refrigeration system absorbs latent heat from liquefied petroleum gas, due to the heat absorbed liquefied petroleum gas gets converted to vapor. The heat absorb by liquefied petroleum gas is equal for latent heat of evaporation of liquefied petroleum gas. This project having creative idea which is suitably commercially in various sectors likes big restaurants, hotels and such places where continuous burning of LPG is required. Due to the introduction of refrigeration circuit in between LPG cylinder and burner there is marginally improvement in calorific value than conventional.

In normal refrigeration circuit use refrigerant to get the refrigerating effect for this to supply power to compressor for this purpose but here inverted LPG gives the cooling effect without any input. The non-conventional refrigeration system works on the principle same as the vapor compression (VCC) refrigeration system. Instead of compressor & condenser use LPG cylinder which has pressure in between 5-7 bar for getting cooling effect.

A. *Operation of Vapor Compression Cycle*

Vapor compression cycle is an improved type of air refrigeration cycle in this refrigerant used as working substance. The refrigerants generally used for this purpose are R134a, R12, ammonia (NH_3), carbon dioxide (CO_2) and sulphur- dioxide (SO_2). The refrigerant generally used, don't leave to the system, but it is circulated in the system alternately condensing and evaporating. In evaporating, the refrigerant absorbs its latent heat from the used solution which is for circulating it's around the cold chamber and condensing; it gives out its latent heat to the circulating water of the cooler.

The vapor compression cycle which is used for all purpose of refrigeration. It is used for all industrial purposes from a small domestic refrigerator to a big air conditioning plant.

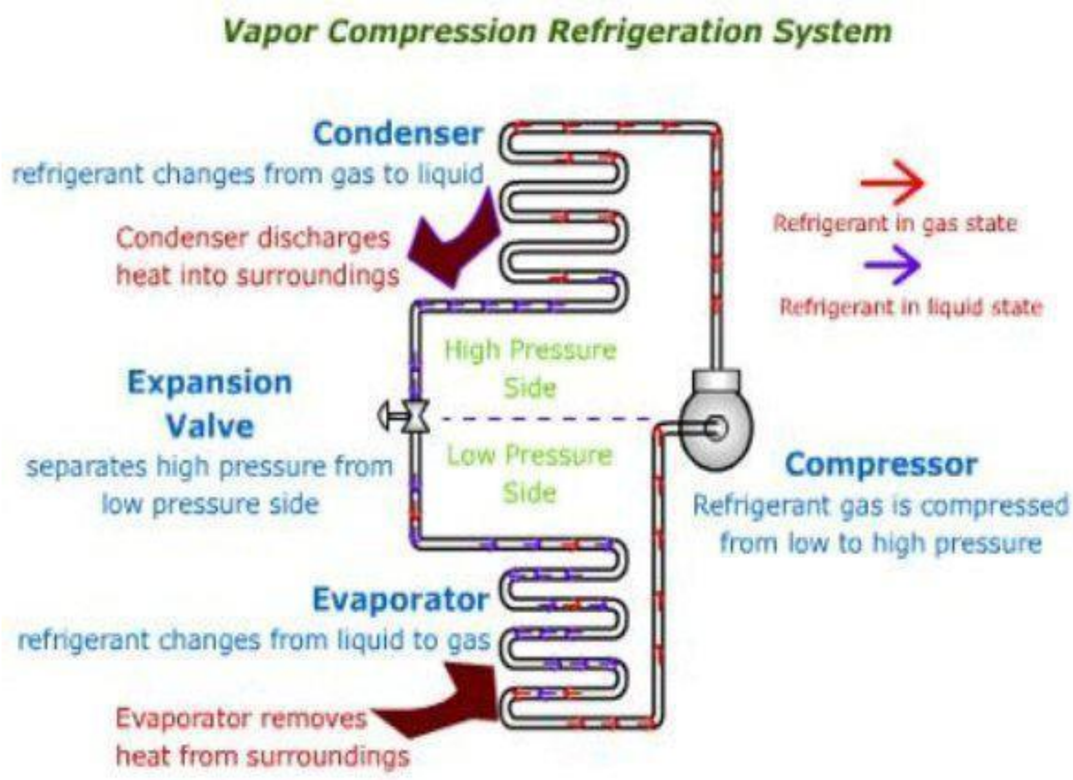

Fig.1 Vapor Compression Cycle

B. Properties of Liquefied Petroleum Gas

LPG is a mixture of both saturated and unsaturated hydrocarbons (Butane and Propane). LPG market in India needs to become governed by Indian Standard Code IS-4576 and the test by the methods IS-1448.

i. Density

LPG at atmospheric pressure and temperature is a gas; it is 1.5 times heavier than air. It is readily or finding liquefied under moderate pressures. The density of the liquid is approximately or near about half that of water and its ranges from 0.5 to 0.580 @ 15 OC.

ii. Vapor Pressure

The pressure inside a LPG cylinder will be equal to the vapor pressure of corresponding temperature of LPG in the storage vessel. The vapor pressure is dependent on temperature as well as on the ratio of mixture of hydrocarbons.

iii. Flammability

LPG has an explosive range of 1.8% to 9.5% volume of gas in air. It gives an indication of hazard of LPG vapor in low lying area in the eventuality of the leakage or spillage.

iv. Combustion

The combustion of LPG increases the volume of refrigerant in addition to the generation of heat. LPG requires up to 50 times its own volume of air for complete combustion.

v. Odor

LPG has only faint smell, and eventually, it is necessary to add some odorant, so that any leakage gas can easily be detected. Ethyl Mercaptan is normally used as stanching agent for this purpose.

vi. Color

LPG is colorless in case of both liquid and vapor. During leakage the vaporization of liquid cools the atmosphere and condenses the water vapor in the form fog which may make it possible to see an escape of LPG.

vii. Toxicity

LPG even though slightly toxic, it isn't poisonous in vapor phase, but suffocates when in large concentrations due to the fact that it displaces oxygen. In view of this the vapor possess mild an aesthetic properties.

C. Component of Non-Conventional Refrigeration System

- LPG Cylinder
- Strainer (filter)
- Capillary Tube
- Regulator
- Evaporator Box
- Digital Thermometer
- Pressure Gauge
- Hose Tubing
- Burner

FABRICATION STAGES

The various stages of fabrication of the NCCS model as Follows:

- Fabrication of frame.
- Attachment of gas, pressure gauge, thermometer, capillary tube, burner.
- Mounting of capillary tube & rigid tube by brazing operation.
- Brazing: - Brazing is a joining process which is used to joining two metals.

These two metals are joined by melting filler metal. Melting point of filler metal should be less than adjoining metal.

Actual and Fabricated Model of Evaporator

Fig.2 Actual Model of Evaporator

Fig.3 Fabricated Model of Evaporator

DESIGN PARAMETER

Table no. 1 Design Parameter

Sr. No.	Name of Parameter	Notation
1.	Time	t
2.	Initial Temperature	Ti
3.	Final Temperature	Tf
4.	Initial Pressure	Pi
5.	Final Pressure	Pf
6.	Heat absorbed in Evaporator cabin	Q(evap.)
7.	Heat Supplied by L.P.G	Q(L.P.G)

FORMULAS

1. Heat absorbed in Evaporator cabin-

$Q_{(evapo)}$ =M*Cp*(Ti-Tf)

Here,

$^{(evapo)}$ = Q Heat absorbed in the evaporator, J/s.

Mass (M) = Mass of air supplied in the evaporator,

Kg. Mass (M) =Volume*Density of air

Cp= Specific Heat of air

2. Heat Supplied by L.P.G –

Q (L.P.G.) = M*Hfg

Here,

Q (L.P.G.) = Heat Supplied by L.P.G, J/s.

M= Mass of LPG, Kg.

Hfg= Latent Heat of L.P.G, KJ/Kg

OBSERVATION TABLE (RESULT)

In this observation table, find out the temperature differences (Ti-Tf) and pressure reducing from initial pressure of LPG at each minute.

Taken the reading at each minute for 20 observations. As per taken observations observed that pressure is reduced its initial value at each observation.

Table no. 2 Observation Table

Time (t)min.	Initial Temp. (Ti)OC	Final Temp. (Tf)OC	Temp. Difference OK	Initial Pressure (Pi)Bar	Final Pressure (Pf)Bar
1	32	29.6	275.4	5.4	5.3
2	32	28.2	276.8	5.4	5.2
3	32	27.3	277.7	5.4	5.2
4	32	26.1	278	5.4	5.1
5	32	25.2	279	5.4	4.9
6	32	23.9	281.1	5.4	4.8
7	32	22.6	282.4	5.4	4.7
8	32	21.8	283.2	5.4	4.7
9	32	20.6	284.4	5.4	4.6
10	32	19.5	285.5	5.4	4.5
11	32	18.2	286.8	5.4	4.5
12	32	17.1	287.9	5.4	4.4
13	32	15.6	289.4	5.4	4.3
14	32	14.2	290.8	5.4	4.2
15	32	12.8	292.2	5.4	4.2
16	32	11.4	293.6	5.4	4.1
17	32	9.8	295.2	5.4	4
18	32	7.9	297.1	5.4	3.9
19	32	6.4	298.6	5.4	3.9
20	32	5.1	299.9	5.4	3.8

DESIGN CALCULATION OF EVAPORATOR

Table no. 3 Heat absorbed in evaporator

Time (t)min.	Temp. difference (Ti-Tf)	Mass (M) Kg.	Specific Heat(Cp) KJ/Kg	Q (Evapo.) J/Sec.
1	275.4	0.481	1	132.4674
2	276.8	0.481	1	133.1408
3	277.7	0.481	1	133.5737
4	278	0.481	1	133.718
5	279	0.481	1	134.199
6	281.1	0.481	1	135.2091
7	282.4	0.481	1	135.8344

8	283.2	0.481	1	136.2192
9	284.4	0.481	1	136.7964
10	285.5	0.481	1	137.3255
11	286.8	0.481	1	137.9508
12	287.9	0.481	1	138.4799
13	289.4	0.481	1	139.2014
14	290.8	0.481	1	139.8748
15	292.2	0.481	1	140.5482
16	293.6	0.481	1	141.2216
17	295.2	0.481	1	141.9912
18	297.1	0.481	1	142.9051
19	298.6	0.481	1	143.6266
20	299.9	0.481	1	144.2519

TESTING AND OBSERVATIONS

Testing is nothing but a critical examination, observation or evaluation. It so the procedure of submitting a statement to such conditions or operations such that will lead to its proof or disproof or to its acceptance or rejection.

A. Testing For Efficient Cooling:

Number of trials are carried out on the model to obtain efficient cooling. The temperature is reduced gradually by designing the capillary in such a manner that the latent heat of evaporation takes place and the cooling effect takes place.

B. Testing For Stable and Reliable Working:

Number of tests were carried out and the system was operated for a long duration to see for the leakages in the system and to see that the model behaves in a proper manner under high pressure. The fabricated models such as capillary and their brazing were also tested to their maximum.

The results concluded that this non-conventional cooling system works properly and provides efficient cooling.

FUTURE SCOPE

India is facing an acute energy scarcity which is hampering its industrial growth and economic progress. Setting up of new power plants is inevitably dependent on import of highly volatile fossil fuels. Thus, it is essential to tackle the energy crisis through judicious utilization of abundant the non- conventional energy resources, such as biomass energy, solar energy, wind energy and geothermal energy. Apart from augmenting the energy supply of renewable resources will help India in to mitigate changing the climate. India is heavily dependent on fossil fuels for its energy needs.

Most of the power generation performed by coal and mineral oil-based power plants they are responsible to greenhouse gases emission. The average per capita consumption of energy in India is around 500 W; it is much lower than that of developed countries like Japan, Europe and USA etc. However, this figure is expected to rise sharply due to high economic growth and rapid industrialization. Energy is a necessity and sustainable non-conventional energy is a vital link in industrialization and development of India.

CONCLUSION

This paper concluded the use of one input get two output. Input is LPG and gets output as cooling effect up to 5 OC in evaporator and gets the pure vapor gas to burner due to this increasing the life and efficiency of gas. In addition, non-conventional energy has the potential to create many employment opportunities at all levels, especially in rural areas. An emphasis on presenting the real picture of massive non-conventional energy potential, it would be possible to attract foreign investments to herald a Green Energy Revolution in India. So the world has already made a beginning to bring about the infrastructural changes in the energy sector so as to be able to choose the non-conventional energy development trajectory.

REFERENCES

I. Ibrahim Husain Shah1 & Kundan Gupta2, “Design of LPG Refrigeration System and Comparative Energy Analysis with Domestic Refrigerator”, (IJESRT) ISSN: 2277-9655, July 2014 PP: 206-213.

II. Shank K. Wang, Handbook of air conditioning and refrigeration” Edition.

III. Baskaran, P. Koshy Mathews, International Journal of Scientific and Research Publications", Volume 2, Issue 9, 1 ISSN 2250-3153, September 2012.

IV. ASHRAE handbook1998.

V. C.P. ARORA, "Hand book of Refrigeration and air conditioning", by page no.425.

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