Car Ac Working On Lpg

Nilesh M. Patil[1], NNandkishor N. Rawool[2], Omkar V. Pawaskar[3], Ranjeet R.Rathod[4]
[1, 2, 3, 4] Dept of Mechanical Department
[1, 2, 3, 4] S.S.P.M college of Engineering , Kankavli

Abstract- *This paper presents a new concept for air-conditioning systems in Liquefied Petroleum Gas (LPG)fuelled vehicles.In this paper we have investigated theperformance ofrefrigerator based on liquefied petroleum gas (LPG) refrigerant since LPG is locally available andis easy to transport anywhere.Earlier to being used in an engine as afuel, LPG enact as a refrigerant. Lpg is extracted in petroleum refineries as a byproduct . Liquefied petroleum gas or liquid petroleum gas comprises of propane , butane , isobutane and flammable mixtures of hydrocarbon gases. Assuredly the air conditioning system is a promising applicationfor LPG-fuelled vehicles to reduce the load on air-conditioning systems.*

Keywords- LPG Refrigeration, LPG, Capillary tube, Evaporator, COP, Refrigerating Effect.

I. INTRODUCTION

Air-conditioning (A/C) systems have been one of the main equipment in vehicles to improve driving comfort since they were first installed in the Packard in 1939 (Bhatti, 1999;Nagengast, 2002). Along with the development of new vehicles ,many changes have been made to improve fuel efficiency, increase environment acceptance, improve passenger and driver comfort, and provide health benefits. In fact, A/C systems have evolved to work automatically to regulate the temperature, humidity, and air quality inside of a cabin (Bhatti, 1999; Shah,2009). However, A/C systems operate via a vapour compression system in which the compressor draws power from the engine.As a result, fuel consumption and CO2 tailpipe emissions increase significantly during A/C use (Benouali et al., 2003;Farrington and Rugh, 2000; Huff et al., 2013; Lee et al., 2013).

II. LITERATURE REVIEW

During the literature review in LPG refrigeration system, Conventional VCR (Vapour Compression Refrigeration System) uses LPG as refrigerant and produced the refrigerating effect .Among the existing gas fuels, CNG and LPG are the most widely used for fleets and private cars, especially on SI engines. Both CNG and LPG produce a potential cooling effect when evaporated within the vaporizer devices. However, in this study we selected LPG because it has a lower cylinder pressure than CNG, which is 0.8–1.0 MPa for LPG and 20- 27 MPa for CNG.Were as in our process very simple type of refrigeration system in which the high pressure LPG is passed through a capillary tube and gets expands, here we can use various capillary tubes of different diameter . During expansion the LPG gets convertedto gases phase from liquid phase .Then this gas is passed through the evaporator where it absorbs the heat and produces the refrigerating effect. After evaporator It passes through the engine of the vehicle which is used as fuel.

III. DISCUSSION

Design of LPG Refrigeration System

There are main four main parts in this system

1. Copper Tubes (For carrying LPG cylinder to filterbefore capillary)
2. Capillary tube
3. Valves (Gas supply control valves)
4. Evaporator

1. Copper Tubes

Air-Conditioning and Refrigeration Systems—

Copper is the preferred material for use with mostrefrigerants. Because of its good heat transfercapacity as well as corrosion resistance and cheaperin cost.As for all materials, the allowable internalpressure for any copper tube in service is based onthe formula used in the American Society of Mechanical Engineers Code forPressure Piping (ASME B31): [**10**]

P = 2S (tmin – C)/ Dmax – 0.8 (tmin – C)

Where:

P = allowable pressure, bar
S = maximum allowable stress in tension, bar
tmin = wall thickness (min.), in mm
Dmax = outside diameter (max.), in mm
C = a constant for copper tube, because of copper's superior corrosion resistance, the B31 code permits

the factor C to be zero. Thus the formula becomes:
P = 2Stmin/Dma – 0.8tmin
According to the pressure 100 psi the tube outside diameter is become = 7 mm and the thickness of the tube is = 1.5 mm.

2. Capillary tube

An analytical computation of length of capillary tube
The fundamental equations applicable to the control volume bounded by points 1and 2 in fig. are
1. Conservation of mass
2. Conservation of energy
3. Conservation of momentum

3. Valves

In this system we have used two flow control valvesof globe type of 4 mm of internal diameter.

4. **Evaporator**

Evaporator is an important component together with other components in a refrigeration system .Evaporators is a device which is used as heat exchangers with fairly uniformwall temperature employed in a wide range ofHVAC-R products, spanning from household toindustrial applications.The reason for refrigeration is to remove heat from air , water or other substance. In general, they are designedto accomplishing a heat transfer duty at thepenalty of pumping power. There are two wellestablishedmethods available for the thermal heatexchanger design, the log-mean temperaturedifference (LMTD) and the effectiveness/number oftransfer units (e-Ntu) approach (Kaka・and Liu,2002; Shah and Sekulic, 2003). The second method is definedas the ratio between the actual heat transfer rate andthe maximum amount that can be transferred, it has beenpreferred to the former as the effectiveness,provides a 1st-law criterion to rank the heatexchanger performance, whereas the number oftransfer units compares the thermal size of the heatexchanger with its capacity of heating or coolingmaterial. Furthermore, the e-Ntu approach avoids thecumbersome iterative solution required by the LMTDfor outlet temperature calculations. [14]In general, evaporators for refrigeration applicationsare designed considering the coil flooded with twophaserefrigerant, and also a wall temperature close tothe refrigerant temperature (Barbosa and Hermes,2012), so that the temperature profiles along thestreams are not constant, in these cases, the heattransfer rate if it is calculated from: [13]

Q = m.cp (To – Ti) = ε.m.cp (Ts − Ti)
Where m =mass flow rate,
Ti= inlettemperature,
To =outlettemperature,
Ts= surface temperature,

Q=h ͽ As (Ts-Tm) is the heat transfer rate, Tm is themean flow temperature over the heat transfer area,As, and ε is the heat exchanger effectiveness,calculated from (Kays and London, 1984):

$$e = 1 - \exp(-NTU)$$

Where NTU is the number of transfer units. We haveselected the plate and tube type evaporator because itprovides a gentle type of evaporation with lowresidence time. It also preserves the food and other products from bacterial attack. It requires low installation cost.

The LPG Refrigeration Cycle

LPG Gas Cylinder:

From the LPG gas cylinder of 14.5 kg, LPG flows through the pipe and reaches to the capillary tube.LPG gas pressure is approximate 12.41 bars.

Capillary Tube:

Capillary tube downs the pressure up to or less than 1.2 bars.

Evaporator:

In the evaporator LPG is converted into the vapour from with low pressure. After passing through the evaporator low pressure and temperature LPG vapour absorbs heat from the chamber system and give the cooling effect .

Gas Burner:

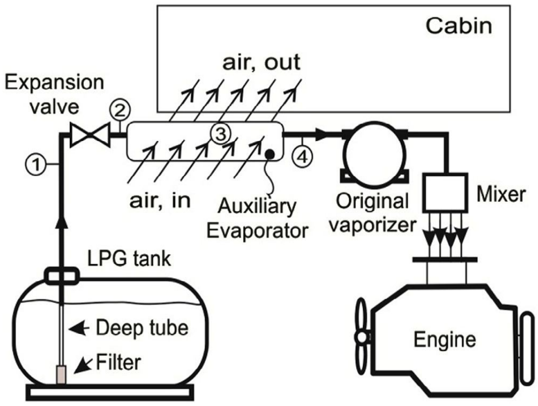
After performing the cooling effect, low pressure LPG gas goes into the burner where it burns. As we know whenever the fluid flow through the narrow pipe there is a pressure drop. The amount of pressure drop in our system is calculated. [10] From the Darcey-Weisbach equation, the pressure drop in the refrigerant piping is calculated for 13 feet length tube is 0.23 in terms of equivalent length.

Basic Experimental Setup of LPG refrigeration system

The main basic components in this system are shown in set up diagram.

Fig.2 Experimental set up

Fig. 3 Experimental set up



IV. RESULTS

Time (in min)	Capillary inlet pressure (in psi)	Evaporator outlet Pressure (in psi)	Evapourator temp. (in oC)
0	65	10	35
5	65	10	33.8
10	65	10	29.9
15	65	10	27.4
20	65	10	26.5
25	65	10	24.8
30	65	10	22.5
35	65	10	22.5

V. ACKNOWLEDGMENT

We would like to express our special thanks of gratitude to Prof. Mr. Yuvraj J. Awalekaras well as our Head Of Department Mr.Vanjari sir who gave us the golden opportunity to do this wonderful project on the topic CAR AC WORKING ON LPG ,which also helped us in doing a lot of Research and we came to know about lot of things we really thankful to them.

We would l also like to thanks our parents and friends who helped us a lot in finalizing this project within a limited time frame.

VI. CONCLUSION

In this modern technological world, peoples always gives first preference to the cost and causes of each operation. So we have designed a new refrigeration system known as “CAR AC WORKING ON LPG ” along with the WORKING OF CAR ENGINE .By comparing existing cars which includes running parts used for refrigeration in car . So finally we conclude that our refrigeration system requires less cost and also increases the value of the product by reducing mechanical losses so that it becomes beneficial form environment point of view by releasing less harmful emission.

REFERENCES

[1] Aleixo, A., Morais, S., Cabezas-Gómez, L., Ricardo, J., 2010. Using engine exhaust gas as energy source for an absorption
refrigeration system. Appl. Energy 87 (4), 1141–1148. doi:10.1016/j.apenergy.2009.07.018. Elsevier Ltd.

[2] Alkan, A., Hosoz, M., 2010. Comparative performance of anautomotive air conditioning system using fixed and variable

capacity compressors. Int. J. Refrigeration 33 (3), 487–495.
doi:10.1016/j.ijrefrig.2009.12.018. Elsevier Ltd and IIR.

[3] Alsaad, M.A., Hammad, M.A., 1998. The application of propane/butane mixture for domestic refrigerators. Appl. Therm. Eng.18 (9–10), 911–918. doi:10.1016/S1359-4311(97)00113-0.

[4] Aly,W.I.A., Abdo, M., Bedair, G., Hassaneen, A.E., 2017. . Appl.
Therm. Eng. 114, 621–630. doi:10.1016/

[5] j.applthermaleng.2016.12.019. Elsevier Ltd.
Fuel consumption of mobile air conditioning method of testing and results. In: The Earth Technology Forum. Washington, pp. 1–10.

[6] Berry, I.M., 2010. The Effects of Driving Style and Vehicle
Performance on the Real-World Fuel Consumption of U.S.
Light-Duty Vehicles. Massachusetts Institute of Technology.

[7] Keyser, M., Rugh, J.P., 2007. An overview of vehicle test and analysis results from NREL's A/C fuel use reduction research. In: VTMS
8 – Vehicle Thermal Management Systems Conference and
Exhibition. National Renewable Energy Laboratory,
Nottingham, England, pp. 567–580.

[8] Bhatti, M.S., 1999. Evolution of automotive air conditioning riding in comfort: part II. ASHRAE J. 41 (9), 44–50.
Calm, J.M., 2008. 1123–1133. doi:10.1016/j.ijrefrig.2008.01.013.

[9] Cesur, I., 2011. The effects of modified ignition timing on cold start HC emissions and WOT performance of an LPG fuelled SI engine with thermal barrier layer coated piston. Int. J. Phys.Sci. 6 (3), 418–424. doi:10.5897/IJPS10.587.

[10] Çengel, Y.A., Boles, M.A., 2007. Thermodynamics: An Engineering Approach, sixth ed. Singapore: McGraw-Hill.

[11] Dahlan, A.A., Zulkifli, A.H., Nasution, H., Aziz, A.A., Perang,

[12] M.R.M., Jamil, H.M., et al., 2014. Efficient and "green" vehicle air conditioning system using electric compressor. Energy Procedia 61, 270–273. doi:10.1016/j.egypro.2014.11.1105.

[13] Dalkilic, A.S.,Wongwises, S., 2010. A performance comparison of vapour-compression refrigeration system using various alternative refrigerants. Int. Commun. Heat Mass Transf. 37(9), 1340–1349. doi:10.1016/j.icheatmasstransfer.2010.07.006.

[14] Elsevier B.V.

[15] El-Morsi, M., 2015. Energy and energy analysis of LPG (liquefied petroleum gas) as a drop in replacement for R134a in domestic refrigerators. Energy 86, 344–353. doi:10.1016/
j.energy.2015.04.035. Elsevier Ltd.

[16] Engineering Toolbox, 2016. Air density and specific weight. http://www.engineeringtoolbox.com/air-density-specific-weight d_600.html. (Accessed 27 April 2017).

[17] ETSAP, 2010. Automotive LPG and natural gas engines. In: © IEA
ETSAP – Technology Brief T03. pp. 1–5. April.

[18] European Committee for Standardization, 2008. CEN – EN 589 –Automotive fuels – LPG – Requirements and test methods ,Engineering 360. http://standards.globalspec.com/std/
1517884/cen-en-589. (Accessed 6 January 2017).

[19] Farrington, R., Rugh, J., 2000. Impact of vehicle air-conditioningon fuel economy, tailpipe emissions, and electric vehiclerange. Earth Technol. Forum http://www.nrel.gov/docs/fy00osti/28960.pdf. September.

[20] Fayazbakhsh, M.A., Bahrami, M., 2013. Comprehensive modelingof vehicle air conditioning loads using heat balance method.SAE Tech. Pap. doi:10.4271/2013-01-1507.

[21] Ghariya, V.J., Gosai, D.C., Gajjar, S.R., 2013. Thermodynamically evolution of LPG refrigerator: a literature review. Int. J. Eng. Res. Technol. 2 (12), 2868–2875.

[22] Guo, Y., Li, G., Chen, H., Hu, Y., 2017. Development of a virtual variable-speed compressor power sensor for variable

[23] refrigerant. Int. J. Refrigeration 74, 71–83.doi:10.1016/j.ijrefrig
.2016.09.025. Elsevier Ltd.

[24] Huff, S.,West, B., Thomas, J., 2013. Effects of air conditioner useon real-world fuel economy. SAE Tech. Pap. doi:10.4271/2013
01-0551.

[25] Jasni, M.A., Nasir, F.M., 2012. Experimental Comparison Study of the Passive Methods in Reducing Car Cabin Interior
Temperature. Penang, pp. 229–233.

[26] Johnson, V.H., 2002. Fuel used for vehicle air conditioning:
a state-by-state thermal comfort-based approach. SAE Tech.
Pap. doi:10.4271/2002-01-1957.

[27] Kim, T.Y., Lee, Y., Kim, C., Shin, M., 2014. Effects of shape and surface roughness on icing and condensation characteristics of an injector in a liquid phase LPG injection system. Fuel 132,
82–92. doi:10.1016/j.fuel.2014.04.010.

[28] Kwak, J.H., Kim, H.S., Lee, J.H., Lee, S.H., 2014. . Int. J. Automot. Technol. 15 (4), 543–551. doi:10.1007/s12239-014-0057-z.

[29] Lee, J., Kim, J., Park, J., Bae, C., 2013. Effect of the air-conditioning system on the fuel economy in a gasoline engine vehicle. Proc. Inst. Mech. Eng. D J. Automob. Eng. 227 (January), 66–77.

[30] Akbari, H., 2011. Potential benefits of solar reflective car shells: cooler cabins, fuel savings and emission reductions. Appl. Energy 88 (12), 4343–4357. doi:10.1016/j.apenergy.2011 .05.006. Elsevier Ltd.

[31] Masi, M., Gobbato, P., 2012. Measure of the volumetric efficiency and evaporator device performance for a liquefied petroleum gas spark ignition engine. Energy Convers. Manag. 60, 18–27.doi:10.1016/j.enconman.2011.11.030. Elsevier Ltd.

[32] Mohan, M., 2013. Zero Cost Refrigeration and Air Conditioning Using LPG. Tech Briefs, Chennai.

[33] Momenimovahed, A., Olfert, J.S., Checkel, M.D., Pathak, S., Sood,V., Robindro, L., et al., 2013. Effect of fuel choice on

[34] Nano particle emission factors in LPG-gasoline bi-fuel vehicles. Int. J. Automot. Technol. 14 (1), 1–11. doi:10.1007/ s12239-013-0001-7.Nagengast, B., 2002. 100 years of air conditioning. ASHRAE J. June, 44–46.Ng, B.C., Darus, I.Z.M., Jamaluddin, H., Kamar, H.M., 2014.

[35] Dynamic modelling of an automotive variable speed air conditioning system using nonlinear autoregressive exogenous neural networks. Appl. Therm. Eng. 73 (1), 1253–1267. doi:10.1016/j.applthermaleng.2014.08.043. Elsevier Ltd.

[36] Shank K. Wang, Handbook of air conditioning and refrigeration" Edition.A. Baskaran, , Volume 2, Issue 9, 1 ISSN 2250-3153, September 2012

[37] B. O. Bolaji, Investigating the performance of some environment-friendly refrigerants as alternative to R12 in vapour compression refrigeration system", PhD Thesis in the

[38] Department of Mechanical Engineering ,Federal University of Technology Akure, Nigeria (2008).Prashant Sharma, Rahul Sharma, "International Journal of Latest Research in Science and Technology" ISSN (Online):2278-5299 Vol.1,Issue 1 :45-48,May-June(2012)ASHRAE, "Thermo physical Properties of Refrigerants", Chapter 20, ASHRAE Fundamental, Inc. Atlanta 20 (2001) 1-67.

[39] W. F Stoecker., and J. W. Jones, "Refrigeration and Air conditioning", TATA McGraw-Hill pub. Co. Ltd.pp. 264.ASHRAE, 2002, "Adiabatic capillary tube