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HYDROCARBON REFRIGERANT VARIATION OF COP, REFRIGERATING EFFECT, POWER, COMPRESSOR WORK WITH EVAPORATING TEMPERATURE FOR CONDENSING TEMPERATURE OF 400C

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ABSTRACT

Today earth's atmosphere survive many problems such as global warming potential (GWP), ozone depletion potential (ODP), climate change, and greenhouse effect. These result showed that environment effected as well as human beings, animals, plants, agriculture, and industry etc. The different layer is made up of the earth atmosphere. Stratosphere is one of the important layers of the atmosphere. Sun emitted high energy ultraviolet (UV) rays; stratosphere ozone absorbs the sun high energy ultraviolet (UV) rays. This layer protects both humans and other living things from exposure to ultraviolet (UV) radiation. In application, refrigeration and air conditioning used quantitatively chlorofluorocarbon (CFCs) and hydro fluorocarbon (HFCs) refrigerant. The chlorofluorocarbon (CFCs) and hydro fluorocarbon (HFCs) release the chlorine in the atmosphere. The presence of chlorine in the stratosphere, result showed that of the migration of chlorine containing chemicals. These chemicals have many unusual properties for examples, low toxicity, non-flammability, and material compatibility that have led to their common widespread use by both consumers and industries around the world. This chlorine depleting the ozone layer. Ozone layer depleted and increases the temperature of the earth surface. The earth surface temperature increases a producing greenhouse effect. In this paper to verify the feasibility of alternative hydrocarbon refrigerants, in place of existing refrigerants.to theoretically analysis the performance of the verified alternative hydrocarbon refrigerants by using NIST's REFPROP software and Cycle_D software, to suggest the best refrigerant from the alternative hydrocarbon refrigerants i.e. the best feasible hydrocarbon refrigerant having low global warming potential (GWP) as well as ozone depletion potential (ODP).

Keyword: UV, GWP, CFC, HFC, ODP.

INTRODUCTION

The department of energy, the discovered of the depletion of the earth ozone layer. These ozone layer proofing and shielding the earth surface from ultraviolet (UV) radiation. The general consensus for the cause of this is that chlorofluorocarbon (CFCs) and hydro fluorocarbon (HFCs) are large class atoms continues to convert more ozone to oxygen. According to protocol, chlorofluorocarbon (CFCs) has been banned in developed countries since 1996, and in 2030, producing and using of chlorofluorocarbon (CFCs) will be prohibited completely in the entire world. Similarly, international treaties demanding a gradual phase out of halogenated hydro fluorocarbon (HFCs) are bound to be prohibited in the near future. The negative effect of chlorofluorocarbon (CFCs) and hydro fluorocarbon (HFCs) on the ozone layer and increase global warming potential (GWP). Need to be replace these existing refrigerant, substitute of the natural refrigerant is the best way. These natural refrigerants like hydrocarbon, water, air, carbon dioxide and ammonia are only refrigerants substitute of an existing refrigerants. Natural refrigerant have zero ozone depletion potential (ODP), negligible global warming potential (GWP) and low environment impacts in production (R.Q. Recardo, 2007). In recent times, ozone depletion potential (ODP) and global warming potential (GWP) have become the most important criteria in the development of new refrigerants afar from the refrigerants chlorofluorocarbon (CFCs) and hydrofluorocarbon (HFCs),both of which have high ODP and GWP, due to their contribution to ozone layer depletion and global warming. Many research results show that the ozone layer is being depleted due to the existence of chlorine in the stratosphere. Uneventful consensus for the prime mover of this that chlorofluorocarbon (CFCs) and hydrofluorocarbon (HFCs) are substantial class of chlorine containing chemicals which immigrate to react ozone. The R134a was the first chlorine free refrigerants discovered (Bolaji, 2013). R134a is used forthwith, as the working fluid in domestic refrigerators. But, it was erect that the R134a access significantly to the worlds green house, global warming problem. These caused to investigating more environment friendly refrigerants than R134a for the conservation of the environment. The natural refrigerants i.e. hydrocarbon mixtures as working fluid in refrigeration and air conditioning systems. The possibility of using hydrocarbon mixtures as working fluid to replace R134a in domestic refrigerator has been evaluated through the analysis.

A. Environmental Effects

Chlorofluorocarbon (CFCs) and hydrofluorocarbon (HFCs) are being large scale used in application for refrigerators, air conditioners, propellants in pressurized containers for aerosols, fire extinguishing agents, solvents or cleaning agents in electronic industries or fumigants. These chlorofluorocarbon (CFCs) seem to have various fascinating characteristics such as thermodynamic suitability, thermal and chemical stability, non-toxicity, non-flammability, low cost, material compatibility etc. for the aforementation application. But the use of chlorofluorocarbon (CFCs) is banned many countries or hydrofluorocarbon (HFCs) use nowadays, have become no ozone depletion potential (ODP) but have high global warming potential (GWP). The continued use of hydrofluorocarbon (HFCs) will not be permitted owing to their affliction effect on the stratosphere ozone layer.

B. Need For Alternative Refrigerants

The need of an alternative refrigerant should acquire various desirable emblematic such as safe operation, thermal and chemical stability, material compatibility and low cost. In addition there are other environmental compatibility aspects such as zero ozone depletion potential (ODP), relatively low global warming potential (GWP), and in preference low smog formation potential i.e. should not be aerratic organic compound. Therefore, any substitute should not be inoffensive so creature as well as to the environment regulation. One has to adjustment on other aspects such as flammability, manufacturing feasibility, energy efficiency, import, redesign of the system etc. A few countries in Europe have given special scrutiny for the use of natural fluids like hydrocarbon (HC), ammonia, carbon dioxide, air etc. To avoid the use of synthetic refrigerants like hydrofluorocarbon (HFCs) as much as possible. Use of rightful design modification for prominent safety and standards are being revised to take, these development into consideration.

SIMULATION RESULTS

In this chapter, result and discussion for the data obtained through NIST's REFPROP 7.0 beta software, Cycle_D software and manual evaluation is carried out.The table 1 shows the properties of chloro-fluoro carbon, hydro-fluorocarbon, Propane, Butane and Iso-butane. From the table it is clear that hydrocarbon refrigerants (Propane, Butane and Iso-butane) are feasible alternative refrigerants.

A. Alternative Hydrocarbon Refrigerants

Table 1 Properties of Current and Alternative Hydrocarbon Refrigerants

	R12	R134a	R290	R600	R600a
Molar Mass	120.9	102.03	44.09	58.12	58.12
Triple point Temp. in ^oC	-157.05	-103.3	-187.67	-138.28	-159.59
Boiling point, in ^oC	-29.8	-26.07	-42	-0.55	-11.67
Critical temp. in ^oC	112	101.06	6.67	151.98	134.67
Critical pressure MPa	4.14	4.059	4.24	3.79	3.64
Critical density Kg/m^3	565	511.90	218.50	227.84	224.35
GWP(100 years)	2400	1200	3.3	4	3

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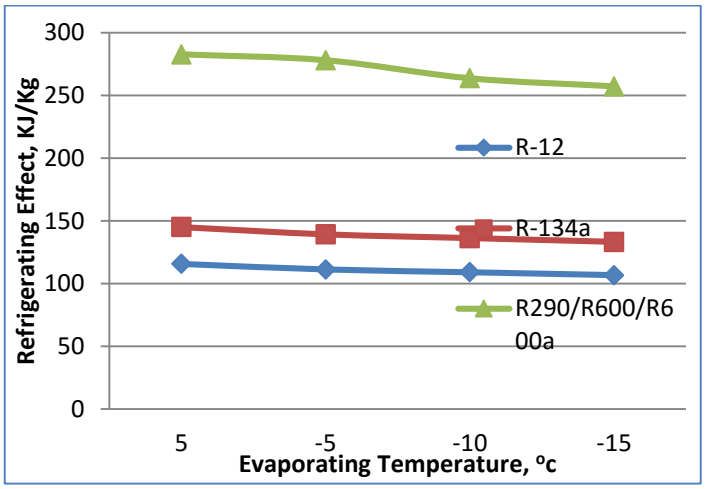

Fig. 1 Variation of refrigerating effect with evaporating temperature for condensing temperature of 40^0c

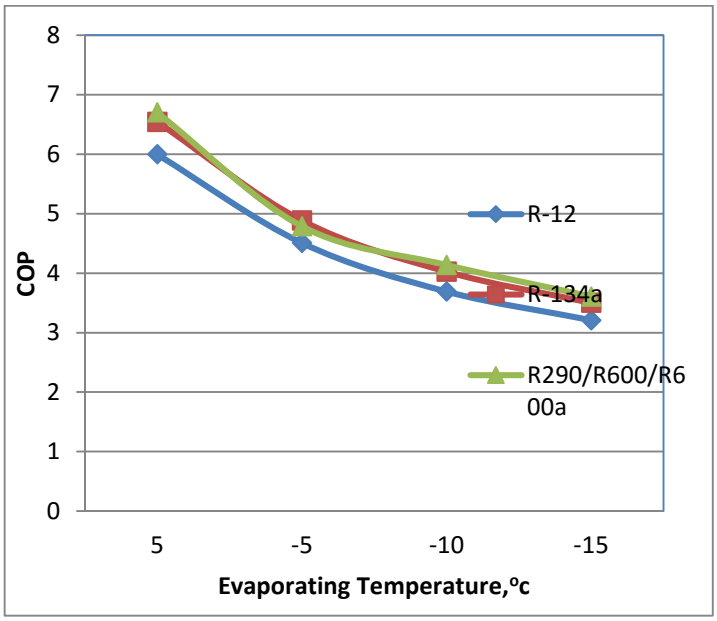

Fig. 2 Variation of COP with evaporating temperature for condensing temperature of 40^0c

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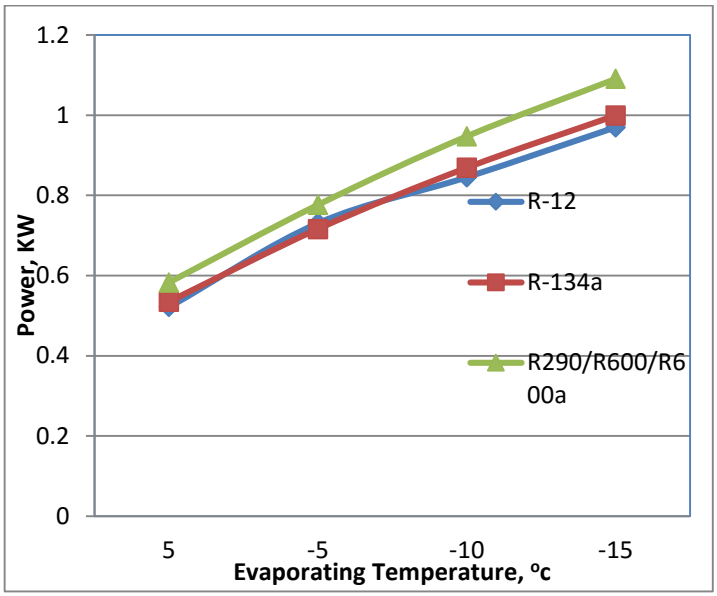

Fig. 3 Variation of power with evaporating temperature for condensing temperature of 40^0c

On theoretical evaluation, the performance of R290, R600, R600a and the blend of R290/R600/R600a (65%/25%/10%) as compared to R12 (Chloro-flouro Carbon) was found to be 7.196%, 2.076%, 2.166% and 10.980% more, respectively. Similarly, the performance of R290, R600, R600a and the blend of R290/R600/R600a as compared to R134a (Hydro-flouro carbon) was found to be 2.651%, 6.228%, 2.166% and 6.274% more, respectively.However, the performance of the blend (R290/R600/R600a) as calculated through simulation using cycle_D software was found to be 2.54.

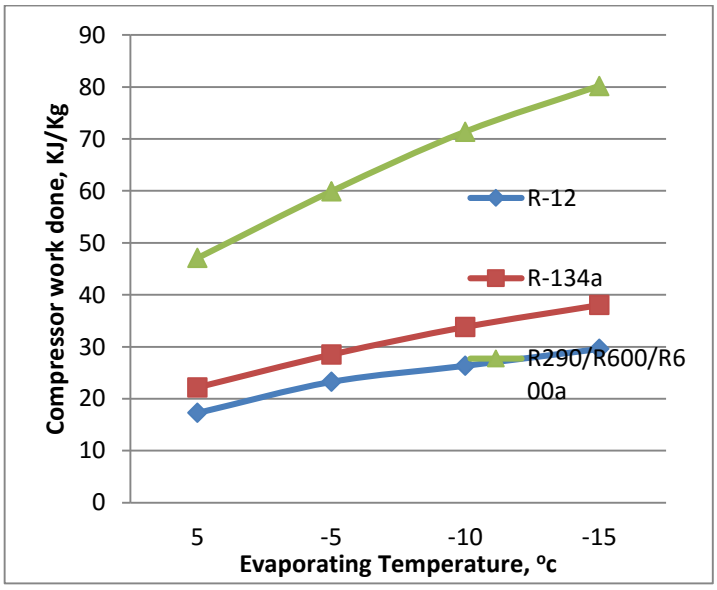

Fig. 4 Variation of compressor work done with evaporating temperature for condensing temperature of 40^0

Best Alternate Hydrocarbon Refrigerant

The best alternate hydrocarbon refrigerant was found to be the blend of Propane (R290), Butane (R600) and Iso-butane (R600a) in the proportion of 65%, 25% and 10% by volume respectively.

SUMMARY AND CONCLUSION

The Present work was undertaken so as to propose hydro-carbon refrigerants as alternate refrigerants for the existing refrigerants, as well as to suggest the best feasible hydrocarbon refrigerant/blend as alternate refrigerant. The

Refprop software was employed to calculate the properties of the refrigerants, whereas, cycle_D software was used for simulation.

On the basis of evaluation, the following conclusions were drawn:

a) Propane (R290), Butane (R600), Iso-butane (R600a) and their blends were found to be feasible alternative for the existing refrigerants.
b) On theoretical evaluation, the performance of R290, R600, R600a and the blend of R290/R600/R600a (65%/25%/10%) as compared to R12 was found to be 7.196%, 2.076%, 2.166% and 10.980% more, respectively. Similarly, the performance of R290, R600, R600a and the blend of R290/R600/R600a as compared to R134a was found to be 2.651%, 6.228%, 2.166% and 6.274% more, respectively.However, the performance of the blend (R290/R600/R600a) as calculated through simulation using cycle_D software was found to be 2.54.
c) The best feasible refrigerant from the alternative hydrocarbon refrigerants was found to be the blend of Propane (R290), Butane (R600) and Iso-butane (R600a) in the proportion of 65%, 25% and 10% by volume respectively.

REFERENCES

1. A. Baskaran, P. Koshy Mathews, 2012. A performance Compression of Vapour Compression Refrigeration System Using Eco Friendly Refrigerants of Low Global Warming Potential. International Journal of Scientific and Research Publications. Volume 2. Issue 9, September.
2. Ahmad Selim DALKILIC, 2012. Theoretical analysis on the prediction of performance coefficient of two-stage cascade refrigeration system using various alternative refrigerants. Journal of Thermal Science and Technology, pp67-79.
3. Amjad Khan, Dr. KuldeepOjha and PrakashGawali, 2013. Analysis of Modern Eco-Friendly Refrigerant. International Journal on Emerging Technologies, pp177-181.
4. Arora C.P., 2013. Refrigeration and Air Conditioning, McGraw Hill Publishers, New Delhi, pp128-208.
5. B.O. Bolaji, m.a.akintunde, and t.o. falade, 2011. Comparative analysis of performance of three ozone-friends HFC Refrigerants in a vapour compression refrigerator. Journal of sustainable Energy & Environment. Vol.2, pp61-64.
6. Bukola O. Bolaji and ZhongieHuan, 2013. Thermodynamic analysis of hydro-carbon refrigerants in a sub-cooling refrigeration system. Journal of Engineering. Vol 1- (1) pp317-333.
7. Jacqueline BianconCopetti, Mario Henrique Macagnan, Mariana Geyer, Rejane De CesaroOliveski, 2005. The Use of Hydrocarbons Propane and Isobutane in Refrigeration Systems. 18th International Congress of Mechanical Engineering. November 6-11
8. Khurmi R.S. and Gupta J. K., 1998. Refrigeration and Air Conditioning, Eurasia Publishers, New Delhi, pp248-266.
9. M. Ashok Chakravarthy, M. L. S. Deva Kumar, 2012. Experimental Investigation of an Alternative Refrigerant for R22 in Window Air Conditioning System. International Journal of Scientific and Research Publications. Volume 2, Issue 10. October
10. Mohamed M. EI-Awad, 2009. A computerized analytical model for evaluating hydrocarbon fluids as natural alternative refrigerants. World Journal of Modelling and Simulation. Vol.5 No. 3. Pp232-240.
11. Mohd. AasimNazeer Ahmad Quraishi, u.s.wankhede, 2013. Use of hydrocarbons and other blends as refrigerant. international Journal of Modern Engineering Research.vol.3.Issue 1, pp250-253.
12. Mohd. AasimNazeer Ahmad, chidanandmangrulkar, ehsanullah khan, syedmohiuddin, 2014. Experimental analysis of refrigerator by replacing conventional HFC refrigerants with hydrocarbons. IOSR Journal of Mechanical and Civil Engineering, pp01-05.
13. N. Austin, P. Senthikumar and S. Purushothaman, 2012. Mixed refrigerants suitability analysis using artificial neutral networks. ARPN Journal of Engineering and Applied Sciences. Vol. 7, No. 5, May.
14. Rafael Quintero Ricardo, 2007. Analysis of the behavior of ternary hydrocarbon mixture as substitutes of the CFC-12. International Conference on Energy and Environment. May 15-17.