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Experimental Study on the Performance Analysis of a Domestic Refrigeration System with Nano Additives and Proven Alternative Refrigerant

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Abstract: Research work has indicated that the performance of the refrigeration system with nano- refrigerant is normal as with that of any other conventional refrigerant. In the research work, the analysis of the performance of the refrigeration system is done with pure refrigerant R134a, pure R290, and blend of R134a+R290, as well as with the mixture of refrigerant R132a and R290 with CuO nano-particles called as nano refrigerants. COP of the nano-refrigerant mixture is increased as compare to the conventional refrigerant. It is also observed that when the concentration of the nano-particles is increased i.e. (R134a+15%R290+0.100%CuO) beyond a certain level adverse effects are also observed like temperatures drop within the condenser was (110.38%) and also a gain of (110.54%) of drop in the evaporator temperature is observed. COP of the system is found to be increased by (133.95%) and power consumption was reduced by (11.52%) with the nano refrigerant as compared with pure refrigerant R134a.
Keywords: Copper Oxide, nanoparticle, thermo-physical properties, temperature drop, condenser and evaporator, energy consumption.

I. INTRODUCTION

Refrigeration may be defined as the process of achieving and maintaining a temperature below that of the surroundings, the aim being to cool some product or space to the required temperature. One of the most important applications of refrigeration has been the preservation of perishable food products by storing them at low temperatures. Refrigeration systems are also used extensively for providing thermal comfort to human beings by means of air conditioning. The refrigeration and air conditioning sector in India has long history from the early years of last century. India is presently producing R134a, R22, R717 and hydro carbon based refrigeration and air conditioning units in large quantities. The use of CFC refrigerants in new systems was stopped since the year 2002. The factors that dictate the adoption of a particular refrigerant apart from its suitability for the specific application are its availability and cost. The halogenated refrigerants such as R12, R22, R134a and natural refrigerant like R717 are readily available at low prices. The Hydrocarbon (HC) and Hydro Fluro Carbon (HFC) mixtures (such as R404a, R407, and R410A) are not currently manufactured indigenously and hence have to be imported at a higher cost. This is likely to affect the growth in refrigeration and air conditioning sector in India and also the total conversion to environmental friendly alternatives in the near future. The Indian household refrigerator industry is more than 50 years old. Eight major domestic refrigerator manufactures were catering this market, of which four are manufacturing hermetic compressors. Domestic refrigerators manufactured in India range in capacities from 65 to 580 l. Most of the currently produced Indian refrigerators uses R134a as refrigerant. The choice of alternative to R134a is narrowed down to R152a and hydrocarbon refrigerants. Refrigerators manufactured before 2000 were still running on R12. To full fill the objectives of the Montreal Protocol, R12 has to be replaced by either hydrocarbon mixtures or R134a/hydrocarbon mixtures without modification in the existing system.

II. LITERATURE

A. Coumaressin and Palaniradja

Evaporating heat transfer is very important in the refrigeration and air-conditioning systems. HFC 134a is the mostly widely used alternative refrigerant in refrigeration equipment such as domestic refrigerators and air conditioners. Though the global warming up potential of HFC134a is relatively high, it is affirmed that it is a long term alternative refrigerants in lots of countries. By addition of nanoparticles to the refrigerant results in improvements in the thermophysical properties and heat transfer characteristics of the

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refrigerant, thereby improving the performance of the refrigeration system. In these experiments the effect of using CuO-R134a in the vapour compression system on the evaporating heat transfer coefficient was investigated by CFD heat transfer analysis using the FLUENT software. An experimental apparatus was build according to the national standards of India. The experimental studies indicate that the refrigeration system with nano-refrigerents works normally. Heat transfer coefficients were evaluated using FLUENT for heat flux ranged from 10 to 40 kW/m2, using nano CuO concentrations ranged from 0.05 to 1% and particle size from 10 to 70 nm. The results indicate that evaporator heat transfer coefficient increases with the usage of nanoCuO.

B. Oluseyi et. al.

Over time attempts have been made to understand the floe characteristics of refrigerant through capillary tube as well as to seek more thermally efficient working fluids for refrigeration systems. This study investigated the flow of nano refrigerants through adiabatic capillary tubes of vapour compression refrigeration system; and afterwards creates numerical models that will account for solution of refrigerant side pressure drop and mass flow rate. Also in this study, a CFD flow analysis was carried out using a CFD simulation/solver such that the result of the simulations obtained were discussed so as to establish a distinction between the conventional and nano-refrigerants. Upon comparison of the CFD results of nano-refrigerents (CuR600a, CuR600a) and the conventional refrigerant (R134a, R600), the conventional refrigerants were noticed to have more isothermal regions implying that heat was not being transferred quickly enough to raise temperature of the adjoining region thus proving that the addition of nanoparticles improves the thermo physical properties of the base fluid. Also, based on the results of the study of the flow patterns of both working fluids, the density of pressure contours in the conventional refrigerants was far larger than that of the nano-refrigerents implying that more compressor work and ultimately greater power will be required. The findings from this study were validated with experimental results showing that a CFD analysis tool/method can be employed to understand the phenomenal changes that take place in nano-refrigerents movement through capillary tubes without recourse to experimentation.

C. Senthilkumara and Praveenb

The application of nano refrigerants in refrigeration system is considered to be a potential way to improve the energy efficiency and to make the use of environment-friendly refrigerants. In this paper we report a method that uses natural gas to enhance the energy efficiency of refrigeration retorting method employing CuO - R600a as alternate refrigerants. Thus reliability and performance of nano refrigerant in the working fluid have been investigated experimentally. A new nano refrigerant is employed in the domestic refrigerator. The performances of the nano refrigerant, such as the cooling capacity, energy efficiency ratio were determined. The results indicate that the mixture of R600a with nano particles (CuO) works normally in the domestic refrigerator. The cooling capacity of the domestic refrigerator is increased by 10 - 20% by using nano – refrigerant. The performance calculation of suction pressure, discharge pressure at no-load, part-load, fully-loaded condition, and running time, COP.

D. Melih et. Al

The topic of Nanofluid heat transfer is certainly of interest to the heat transfer community. Nano-refrigerents are a type of nanofluids that are mixtures of nanoparticles and pure refrigerants. This paper focuses on five different nano-refrigerents with Al2O3 nanoparticles and their pure fluids: R12, R134a, R430a, R436a, and R600a. The coefficient of performance (COP) and compressor work for various evaporation and condensation temperatures are investigated. A method is developed to estimate the performance characteristics of nano-refrigerents in the refrigerant cycles for the nonsuperheating/subcooling case and superheating/subcooling case. The enthalpy of nano-refrigerents is obtained through the density. The validation process of the proposed method was accomplished with the available data in the literature. The results indicate that COP is enhanced by adding nanoparticles to the pure refrigerant and maximum values obtained using the R600a/Al2O3 mixture.

III. OBJECTIVES

The following steps are taken in present study:

The most commonly used commercial refrigerant R134a and the proven alternative R290 were blended and the new hybrid refrigerant was prepared and the heat transfer characteristics will be investigated with different volume concentration.

The blended percentages of R290 is always in a lower side due to flammable properties that’s why we will be taken as 10% and 15% of it to the R134a.

Nano particle size is taken 50 nm and volume percentages are 0.50 % and 0.100 % to the mixture of R134a+R290 .

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IV. RESULTS

The experiment is conducted first with pure refrigerant (R134a) only, and then second, proven alternative refrigerant R290 are blended with 10% of it to the R134a, and then third, with 15 % of it to the R134a and then fourth, experiment is conducted with pure proven alternative refrigerant (R290) only and then fifth with nano-refrigerant (R134a+15%R290+0.50%CuO) and last with (R134a+15%R290+0.100%CuO). During experiment readings are noted as explained in the methodology. These readings are noted for various parameters like voltage, current, temperature, pressure, ambient temperature, energy meter. With the help of the readings different graphs are plotted which compares various parameters as drop of temperature in the condenser, gain in the temperature across that of the evaporator, coefficient of performance (COP) of the refrigeration system and the power consumption during different tests done. Various parameters whose readings are noted are listed below:

Evaporator Outlet Temperature (T1) (in°C)
Condenser Inlet Temperature (T2) (in°C)
Condenser Outlet Temperature (T3) (in°C)
Evaporator Inlet Temperature (T4) (in °C)
Compressor Inlet Pressure (P1) (in psi)
Compressor Outlet Pressure (P2) (in psi)

A. for the pure Refrigerant r134a

Atmospheric temperature = 38,
Reading Note Interval Duration = 30 min,

Table 1: Voltage, Current, Temperature, Pressure, Ambient-Temperature, Energy Meter readings for R134a refrigerant.

TIME (min)	PARAMETERS								
	V	A	T1(°C)	T2(°C)	T3(°C)	T4(°C)	P1 (psi)	P2 (psi)	Ambient Temperature (°C)	Energy Meter (sec)
0	225	1	34.7	38.7	35.1	27.3	5	125	30.5	68
30	225	1	27.1	37.1	31.1	8.1	5	120	29.1	67
60	225	1	9.1	39.2	32.8	-16	5	120	29.7	66
90	225	1	8.6	40.4	33.3	-16.6	6	120	22.9	64
120	225	1	8.8	40.9	33.2	-16.8	4	120	16	65

B. for the blend (r134a+10%r290)

ATMOSPHERIC TEMPERATURE = **37**,
Reading Note Interval Duration = **30 min,**

TABLE 2:- Voltage, Current, Temperature, Pressure, Ambient-Temperature, Energy Meter readings for R134a+R290 with 10% R290 of it to R134a.

TIME (min)	PARAMETERS									
	V	A	T1(°C)	T2(°C)	T3(°C)	T4(°C)	P1 (psi)	P2 (psi)	Ambient Temperature (°C)	Energy Meter (sec)
0	225	1	38.1	39.6	32.8	26.7	10	220	30.5	70
30	220	0.6	29.7	38.8		-11.2	5	220	22.7	72
60	220	0.6	28.9	40.5	33.2	-22.5	5	230	13	71
90	220	0.6	28.4	41.2	33.5	-23.8	5	225	6.9	71
120	220	0.6	28.2	41.9	33.8	-24.2	5	225	3.1	72

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C. for the blend (r134a+15%r290)

ATMOSPHERIC TEMPERATURE = 38,

Reading Note Interval Duration = 30 min,

TABLE 3:- Voltage, Current, Temperature, Pressure, Ambient-Temperature, Energy Meter reading for R134a+R290 with 15% R290 of it To R134a.

TIME (min)	PARAMETERS								
	V	A	T1(°C)	T2(°C)	T3(°C)	T4(°C)	P1 (psi)	P2 (psi)	Ambient Temperature (°C)	Energy Meter (sec)
0	220	0.8	32.4	44.3	35.1	15.8	16	260	30.5	72
30	220	0.8	27.6	45.9	35.9	-20.0	16	250	20.2	72
60	220	0.8	26.9	45.7	36	-24.6	16	250	11	73
90	220	0.8	26.6	46.6	36.2	-25.8	16	250	5.3	72
120	220	0.8	26.1	46.9	36.4	-26.8	16	250	2.4	73

D. For The Pure Refrigerant R290

ATMOSPHERIC TEMPERATURE = 36,

Reading Note Interval Duration = 30 min,

TABLE 4:- Voltage, Current, Temperature, Pressure, Ambient-Temperature, Energy Meter readings for Pure R290, 40% of it to R134a

TIME (min)	PARAMETERS									
	V	A	T1(°C)	T2(°C)	T3(°C)	T4(°C)	P1 (psi)	P2 (psi)	Ambient Temperature (°C)	Energy Meter (sec)
0	220	0.6	31.3	40.5		10.5	6	160	30.5	60
30	220	0.6	31.7	40.6		-11.4	5	160	11.7	69
60	215	0.6	30.7	41.1	35.9	-19.4	6	160	8.3	69
90	215	0.6	30.5	41.3	36	-22.4	6	160	7.1	70
120	220	0.6	30.6	41.5	36.1	-22.9	6	140	3.3	70

E. for the blend (r134a+15%r290+0.50%cuo)

ATMOSPHERIC TEMPERATURE = 36,

Reading Note Interval Duration = 30 min,

TABLE 5:- Voltage, Current, Temperature, Pressure, Ambient-Temperature, Energy Meter reading for (R134a+R290+5%CuO)

TIME (min)	PARAMETERS									
	V	A	T1(°C)	T2(°C)	T3(°C)	T4(°C)	P1 (psi)	P2 (psi)	Ambient Temperature (°C)	Energy Meter (sec)
0	220	0.8	33.8	45.4	36.1	2.6	10	200	30.5	72
30	220	0.8	26.9	46.9		-21.2	5	205	10.2	73
60	220	0.8	26.4	46.5	33.2	-25.1	5	200	6	74
90	220	0.8	25.3	46.4	32.6	-26.5	5	200	3.1	74
120	220	0.8	25.5	46.9	32.8	-28.3	5	210	1.0	75

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F. for the blend (r134a+15%r290+0.100%cuo)

ATMOSPHERIC TEMPERATURE = 36

Reading Note Interval Duration = 30 min

TABLE 6:- Voltage, Current, Temperature, Pressure, Ambient-Temperature, Energy Meter readings for (R134a+R290+10%CuO)

TIME (min)	PARAMETERS								
	V	A	T1(°C)	T2(°C)	T3(°C)	T4(°C)	P1 (psi)	P2 (psi)	Ambient Temperature (°C)	Energy Meter (sec)
0	220	0.8	32.9	46.4	35.3	2.2	14	202	30.5	73
30	220	0.8	25.6	46.9		-26	10	220	9.7	73
60	220	0.8	25.8	47.2	32.7	-27	10	210	5	75
90	220	0.8	24.6	47.4	31.9	-27.5	10	210	0.7	76
120	220	0.8	25.8	47.9	31.7	-28.1	10	210	0.5	76

G. Drop In Temperature Across The Condenser

WORKING FLUID	TIME				
	0 Min	30 Min	60 Min	90 Min	120 Min
PURE R134a	3.6	6	6.4	7.1	7.7
R134a+10%R290	6.8	5.8	7.3	7.7	8.1
R134a+15%R290	9.2	10	9.7	10.4	10.5
PURE R290	5.1	4.8	5.2	5.3	5.4
R134a+15%R290+0.50%CuO	9.3	13.4	13.3	13.8	14.1
R134a+15%R290+0.100%CuO	11.1	14.4	14.5	15.5	16.2

H. Gains in Temperature Across Evaporator

WORKING FLUID	TIME				
	0 Min	30 Min	60 Min	90 Min	120 Min
PURE R134a	7.4	19	25.1	25.2	25.6
R134a+10%R290	11.4	40.9	51.4	52.2	52.4
R134a+15%R290	16.6	47.6	51.5	52.4	52.9
PURE R290	20.8	43.1	50.1	52.9	53.5
R134a+15%R290+0.50%CuO	31.2	48.1	51.5	51.8	53.8
R134a+15%R290+0.100%CuO	30.8	51.6	52.8	52.1	53.9

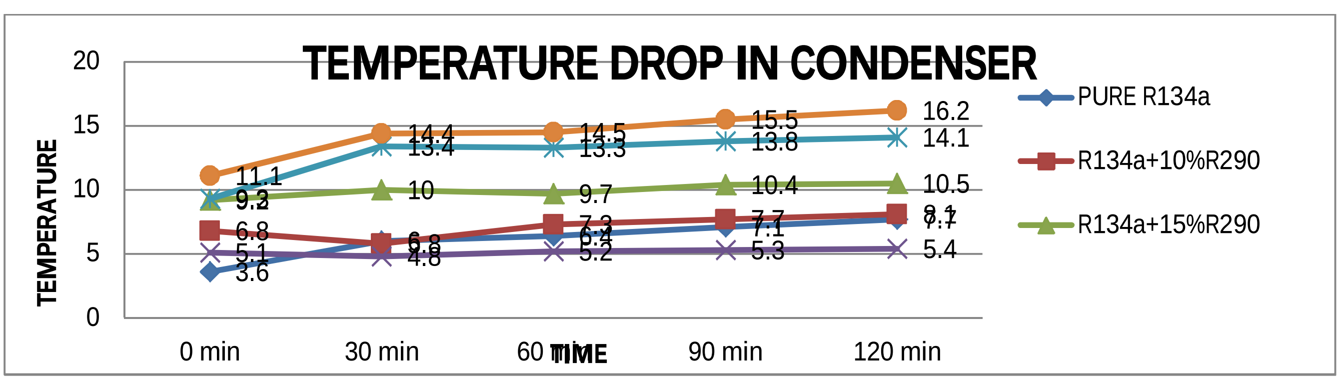

Figure 1

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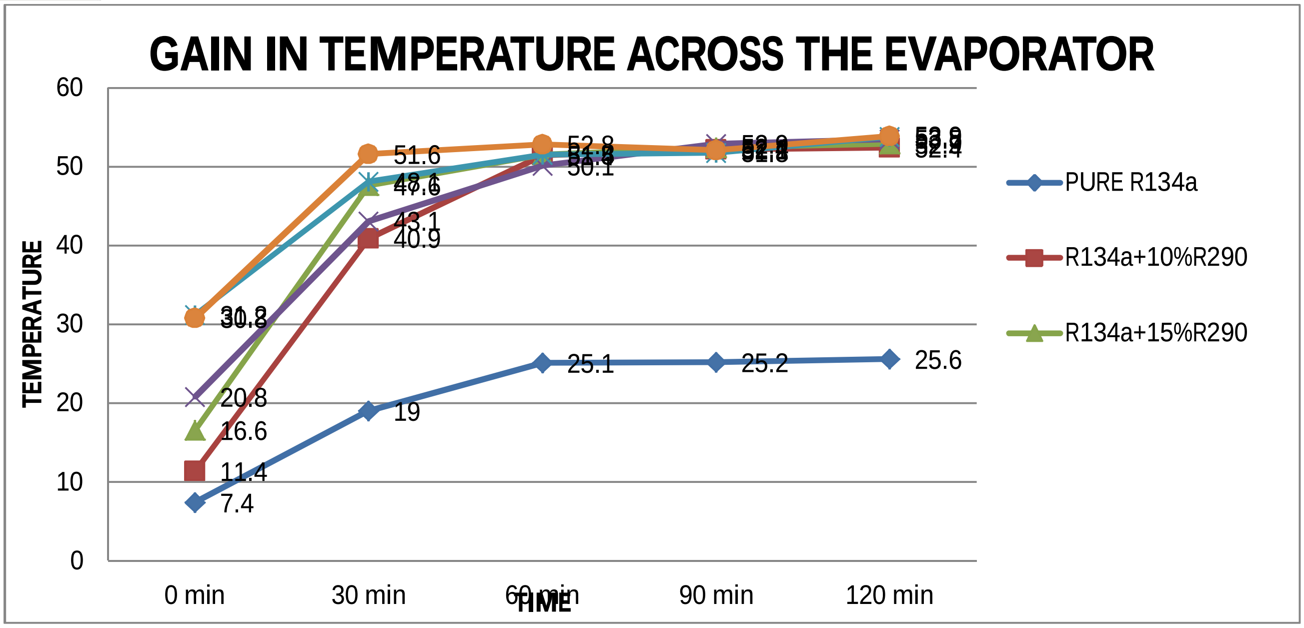
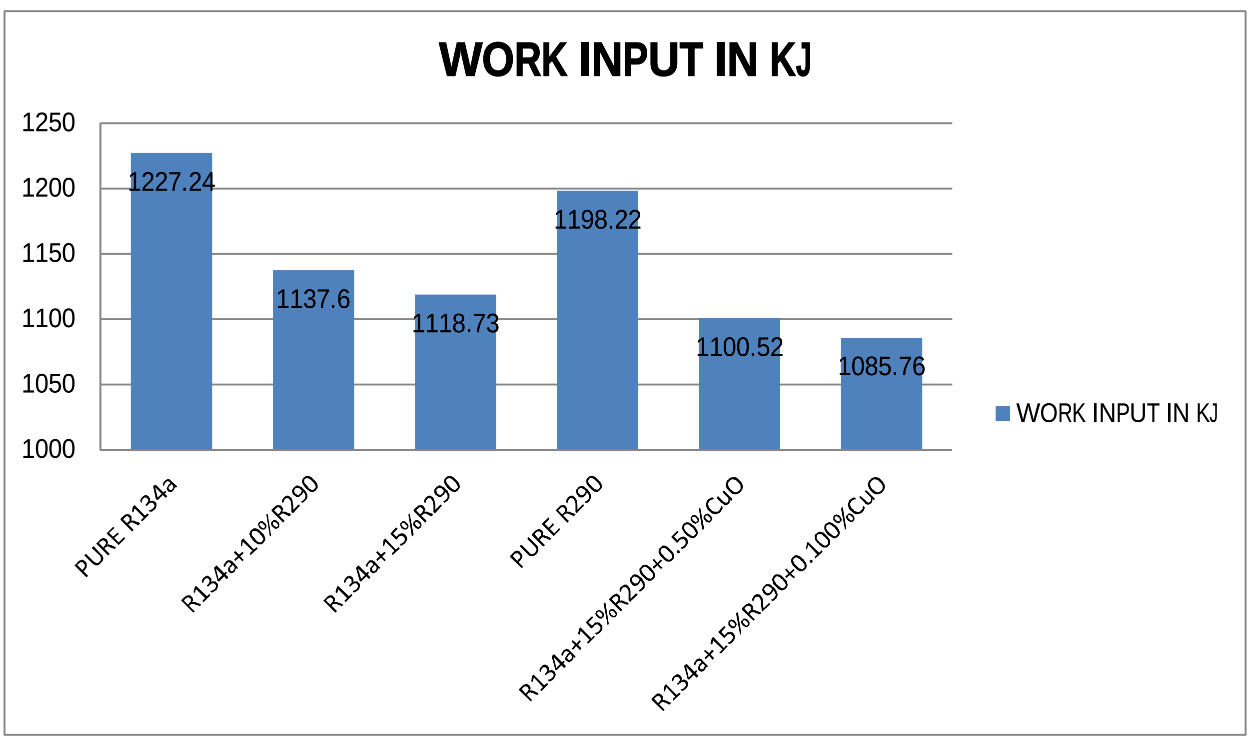


Figure 2

Table 4.9 :- Work Input to the compressor For 2 Hour Operation

WORKING FLUID	WORK INPUT IN (KJ)
Pure R134a	1227.24
R134a+10%R290	1137.6
R134a+15%R290	1118.736
Pure R290	1198.224
R134a+15%R290+0.50%CuO	1100.52
R134a+15%R290+0.100%CuO	1085.76



Work Input To The Compressor In Kj

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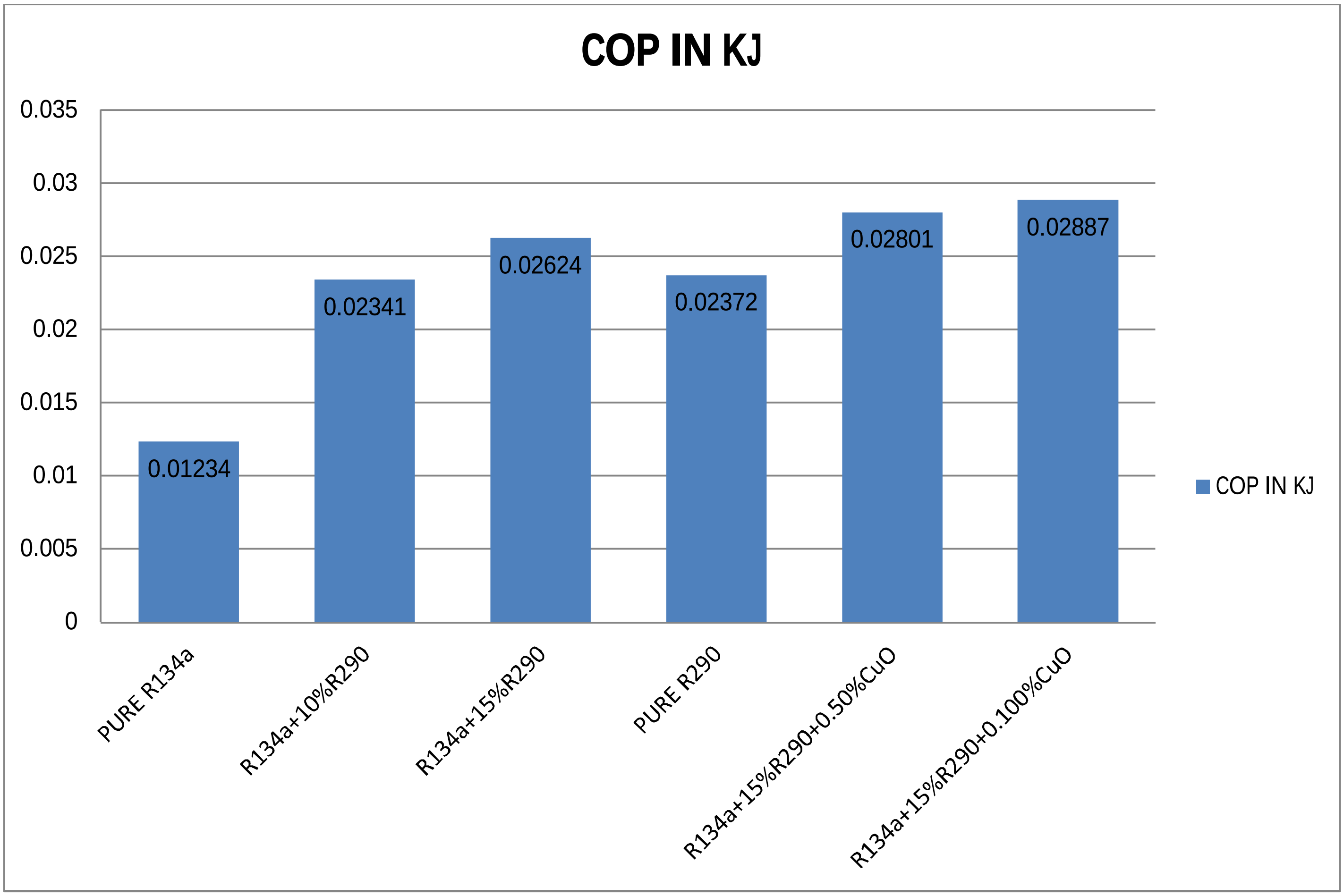
table 4.11 cop table

WORKING FLUID	COP
R134a	0.01234
R134a+10%R290	0.02341
R134a+15%R290	0.02624
R290	0.02372
R134+15%R290+0.50%CuO	0.02801
R134a+15%R290+0.100%CuO	0.02887

Cop Of Working Fluids



IV. CONCLUSION

A. The following are the key steps and conclusion drawn from the experimentation work:

1) In present study We have taken two concentration of the R290 refrigerant i.e. 10 % and 15 % were taken to that of it to R134a.Two concentrations of the CuO nano particles that are 0.50 % and 0.100 % to that of the pure refrigerant R134a and 15%R290 were chosen and system was charged

2) At constant volume flow rate the readings were noted down.

3) For both the concentration of the nano particles in that of the mixture of refrigerant R134a and R290 and with that of the pure refrigerants tests were conducted and using the readings obtained so analysis of the temperature drop across the condenser, temperature gain in that of the evaporator, COP for the system and power consumption by that of the compressor is done by plotting graphs and drawing tables respectively.

4) Through experimentation it is interpreted that on addition of the CuO particles to that of the refrigerant R134a and R290 the thermo physical properties as well as the heat transfer characteristics are seen to be improved

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5) When comparing blend (R134a+10%R290) with R134a pure refrigerant, there is increase in temperature drop in condenser is 5.19 % and increase in gain in temperature in evaporator by (104.68 %) .In the same research work an improvement in the COP By (89.70%) as well as the reduction in the power consumption of that of the compressor is observed by (7.30 %)
6) When comparing R134a+15%R290 with R134a, there is increase in temp drop in condenser is 36.36 % and increase in gain in temperature in evaporator by (106.64%) . In the same research work an improvement in the COP By (112.72 %) as well as the reduction in the power consumption of that of the compressor is observed by (8.84 %).
7) When comparing R290 with R134a, there is increase in temp drop in condenser is (29.87 %) and increase in gain in temperature in evaporator by (108.98%) . In the same research work an improvement in the COP By (92.22%) as well as the reduction in the power consumption of that of the compressor is observed by (2.36%).
8) Through research work it is revealed that for (R134a+15%R290+0.50%CuO) the drop in temperature across that of the condenser is (83.11%) higher for that of the nano refrigerant when compared with the pure refrigerant R134a. In the similar fashion we obtain a gain of (110.15%) for that of the temperature within the evaporator. In the same research work an improvement in the COP By (126.98%) as well as the reduction in the power consumption of that of the compressor is observed by (10.32%).
9) Along with above favourable effects for (R134a+15%R290+0.100%CuO) certain adverse effects have also been observed like for the consumption of the nano particles beyond certain amount temperature drop within the condenser is higher for the nano refrigerant by (110.38%) relative to that of the pure refrigerant R134a and gain of temperature is (110.54%) in that of the temperature across the evaporator is obtained. Together with this COP is found to gain by (133.95%) and power consumption of that of the compressor is seen to be reduced by (11.52) %
10) During the experimentation power consumption is seen to be lowered for a particular concentration of the nano particles by (10.32%) but as the concentration is increases beyond certain level there is also an increase in reduction of the power consumption by (11.52%)
11) Also the experiment indicates that the performance of the system is normal and usual with that of the nano refrigerant as with that of any other conventional refrigerant.

REFERECNES

[1] T. Coumaressin1 and K. Palaniradja2 , "Performance Analysis of a Refrigeration System Using Nano Fluid", International Journal of Advanced Mechanical Engineering. ISSN 2250-3234 Volume 4, Number 5 (2014), pp. 521-532 © Research India Publications, http://www.ripublication.com/ijame.htm
[2] Oluseyi O. Ajayi, Doroythy E. Ibia, Mercy Ogbonnaya, Ameh Attabo, Agarana Michael , "CFD analysis of nano refrigerant through adiabatic capillary tube of vapour compression refrigeration system" , Procedia Manufacturing 7 (2017) 688-695, www.sciencedirect.com
[3] A.Senthilkumara, R.Praveenb, "PERFORMANCE ANALYSIS OF A DOMESTIC REFRIGERATOR USING CUO –R600A NANO – REFRIGERANT AS WORKING FLUID", JCHPS Special Issue 9: April 2015, www.jchps.com
[4] MelihAktas,1 AhmetSelimDalkilic,1 AliCelen,1 AlicanCebi,1 OmidMahian,2 andSomchaiWongwises3, "A Theoretical Comparative Study on Nanorefrigerant Performance in a Single-Stage Vapor-Compression Refrigeration Cycle", Hindawi Publishing Corporation Advances in Mechanical Engineering Article ID 138725
[5] Luke O. Ajuka 1*, Moradeyo K. Odunfa 1, Olayinka S. Ohunakin 2, Miracle O. Oyewola 1, "Energy and exergy analysis of vapour compression refrigeration system using selected eco-friendly hydrocarbon refrigerants enhanced with tio2-nanoparticle", International Journal of Engineering & Technology, 6 (4) (2017) 91-97
[6] Prabhat Kumar Singh*1, Yogesh Tembhurne2 & Vijaykant Pandey3, "A REVIEW ON NUMERICAL ANALYSIS OF A REFRIGERATION SYSTEM USING DIFFERENT NANO FLUIDS BY CFD", Singh* et al., 7(3): March, 2018
[7] M.V.Duarte,L.C.Pires,P.D.Silva*,andP.D.Gaspar, "Experimental comparison between R409A and R437A performance in a heat pump unit", OpenEng.2017;7:77–90
[8] Mark A. Kedzierski, "Effect of Concentration on R134a/Al2O3 Nanolubricant Mixture Boiling on a Reentrant Cavity Surface with Extensive Measurement and Analysis Details", National Institute of Standards and Technology Technical Note 1813 Natl. Inst. Stand. Technol. Tech. Note 1813, 51 pages (September 2013
[9] Liu Yang1,2* and Yuhan Hu1, "Toward TiO2 Nanofluids—Part 2: Applications and Challenges", Yang and Hu Nanoscale Research Letters (2017) 12:446 DOI 10.1186/s11671-017-2185-7
[10] Warren Russell Long, "DISTRIBUTION MAP OF MULTI-WALLED CARBON NANOTUBES IN A REFRIGERANT/OIL MIXTURE WITHIN A 2.5 TON UNITARY AIR-CONDITIONER", (2012).Theses and Dissertations. 586
[11] M. E. Uwadiae1,*, M. A. Akintunde2 and T. I. Ogedengbe3, "EXPERIMENTAL INVESTIGATION OF R-134a AND R-600a REFRIGERANT BLEND IN DOMESTIC VAPOUR COMPRESSION REFRIGERATION SYSTEM" , Nigerian Journal of Technology (NIJOTECH) Vol. 36, No. 4, October 2017, pp. 1138 – 1144 Copyright© Faculty of Engineering, University of Nigeria, Nsukka, Print ISSN: 0331-8443, Electronic ISSN: 2467-8821 www.nijotech.com http://dx.doi.org/10.4314/njt.v36i4.20
[12] Mark O. McLinden Arno Laesecke Eric W. Lemmon Joseph W. Magee Richard A. Perkins, "PROPERTIES AND CYCLE PERFORMANCE OF REFRIGERANT BLENDS OPERATING NEAR AND ABOVE THE REFRIGERANT CRITICAL POINT", U.S. Department of Commerce National Technical Information Service 5285 Port Royal Road Springfield, VA 22161 (703) 487-465

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[13] #1M.S.Bandgar, #2Dr. K. P. Kolhe, #3Dr. S.S.Ragi, "An experimental investigation of VCRS by addition of nano-SiO2 as lubricant additives", International Engineering Research Journal (IERJ) Special Issue Page 81-89, June 2016, ISSN 2395-162

[14] Jatinder Gill a,*, Jagdev Singh b, "An applicability of ANFIS approach for depicting energetic performance ofVCRS using mixture of R134a and LPG as refrigerant", international journal of refrigeration 85 (2018) 353–375

[15] D.Sánchez[a]R.Cabello[a]R.Llopis[a]I.Arauzo[a]J.Catalán-Gil[a]E.Torrella[b], "Energy performance evaluation of R1234yf, R1234ze(E), R600a, R290 and R152a as lowGWP R134a alternatives", International Journal of Refrigeration · September 2016 DOI: 10.1016/j.ijrefrig.2016.09.02

[16] #1Shrikant Dhavale , #2Manish Deshmukh, "Performance Study of Geotropic Blends of Isobutane R600a and Propane R290 in Domestic Refrigerator as Alternative Refrigerants to R134a .", International Engineering Research Journal (IERJ) Special Issue 2 Page 4889-4893, 2015, ISSN 2395-162

[17] Jianbo Bai1, Yang Li and Jianhao Chen, "Real-time performance assessment and adaptive control for a water chiller unit in an HVAC system", IOP Conf. Series: Earth and Environmental Science 121 (2018) 052005 doi :10.1088/1755-1315/121/5/052005

[18] performance in an R134a small capacity refrigeration unit", International Journal of Refrigeration (2017), http://dx.doi.org/doi: 10.1016/j.ijrefrig.2017.08.01

[19] Jagnarayan Rawani1, Satyendra Kumar Prasad2, Jitendra Nath Mahto3, "Performance Analysis of Mixtures of R290 and R600a With Respect To R134a in Simple Vapour Compression Refrigeration System." , International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 6, June 20

[20] Safvan Khansaheb1, Dr. R.G Kapadia2, "A Review on Domestic Refrigerator Using Hydrocarbons as Alternative Refrigerants to R134a", International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 4, Special Issue 6, May 201

[21] Yetti Siva1 , Dr.Smt.G.Prasanthi M.E.,Ph.D.2, "Performance Analysis of Eco-Friendly HC Mixture (R290/R600a) Refrigerant as an Alternative to R-134a in a Vapour Compression Refrigeration System for Sub-cooling using Heat Exchanger at Condenser Outlet and Diffuser at Condenser Inlet", IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 12, December 2015

[22] D.V.Raghunatha Reddy, P.Bhramara, K.Govindarajulu, "Hydrocarbon Refrigerant mixtures as an alternative to R134a in Domestic Refrigeration system: The state-ofthe-art review", International Journal of Scientific & Engineering Research, Volume 7, Issue 6, June-2016

[23] SANKET BORKAR, "SUBSTITUTION OF NON-ECOFRIENDLY REFRIGERANTS BY HYDROCARBON REFRIGERANTS: A REVIEW", International Journal of Advances in Science Engineering and Technology, ISSN: 2321-9009, Spl. Issue-2 Feb.-2016

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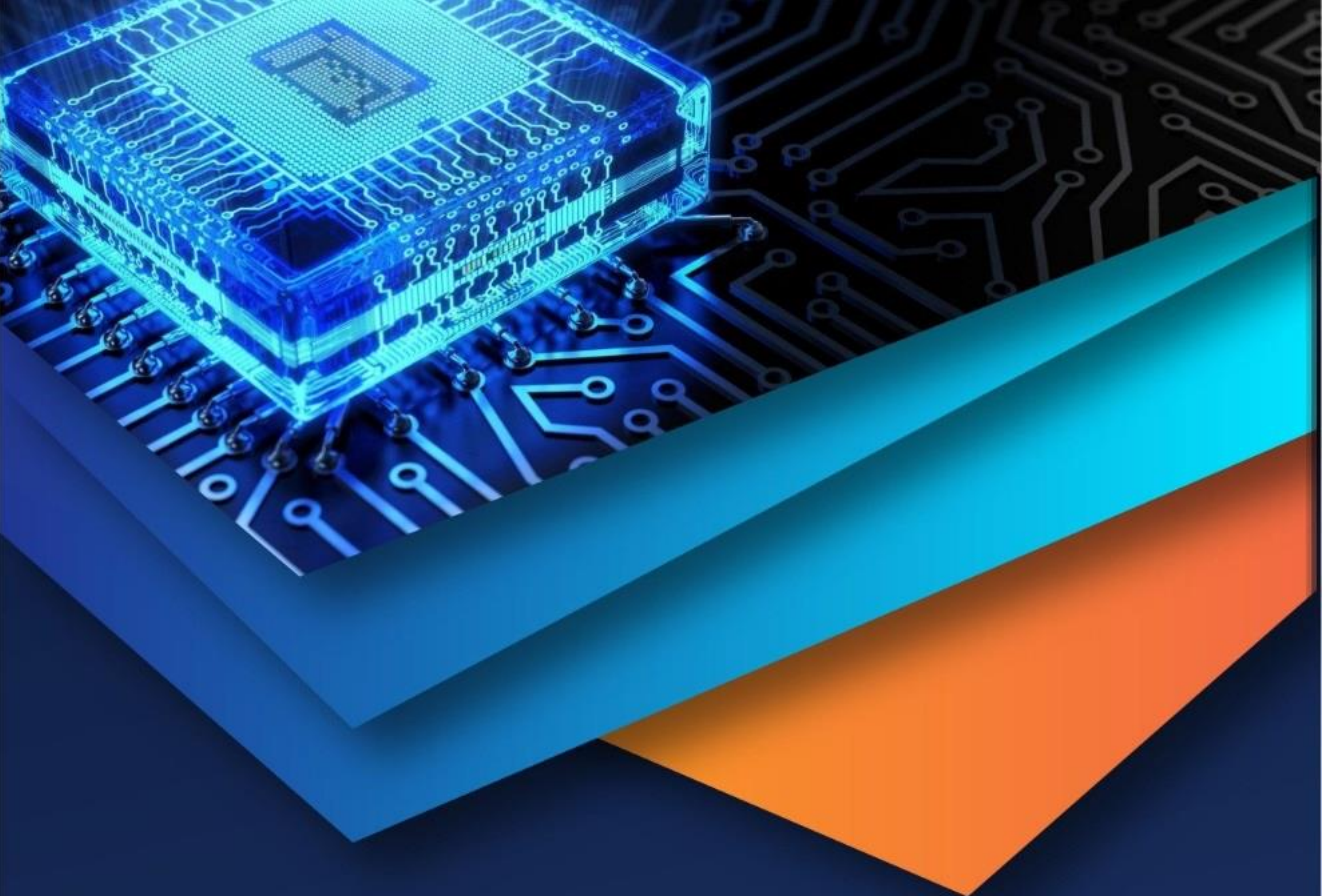

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