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"AN EVALUATION AND PERFORMANCE COMPARISON OF ECOFRIENDLY REFRIGERANTS"

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ABSTRACT

R134a (1,1,1,2-tetrafluoroethane) has been used in domestic as well as commercial purpose in many vapour compression refrigeration system. Although it has zero ozone depleting potential but its high global warming potential of 1300 is a serious issue. Due to that high it needs to phase out from vapour compression refrigeration (VCR) cycle. The EU (European union) F-gas regulation has taken effect from January 1,2015. The regulation implies or applied an HFC (hydrofluoro carbon) phase-down from 2015 to 2030 by means of bans on high GWP refrigerants. R134a is especially under pressure and more likely to be phased out (not to be used) of all commercial systems. This paper explains the possible replacement of R134a from vapour compression refrigeration cycle. The basis of replacement is to analyze an ice plant working on R134a as refrigerant. Pressure and temperature reading of the plant has been taken. Based on the working pressure and temperature theoretical cop of the plant is calculated using P-h chart of R134a. R134a is replaced with mixture of three refrigerant R32, R152a and R245a in definite proportion. All the three refrigerant replacing R134a have global warming potential less than R134a. Mixture of refrigerant obtained to replace R134a is analyzed on the basis of their COP, GWP, their density, enthalpy and entropy in liquid as well as in vapour phase. Based on our experimental analysis of two refrigerant can be selected as possible replacement of R-134a namely M1 and M2 having R32, R152a and R245a in ratio by mass as 0.1:0.4:0.5 and 0.1:0.5:0.4 respectively. Also due comparatively low GWP, M2 composition can be suggested as best possible replacement out of M1 and M2.

Keyword: *ODP, GWP, COP, R152a, R134a, Refrigerant, Vapour, Compression, Enthalpy, Entropy, Density.*

I. INTRODUCTION

Refrigeration will be laid out a method of moving or transferring heat from one area or point to an alternate area or point. basically it's a craft of keeping up temp of framework not exactly surrounding and it will be accomplished by transferring heat from lower to higher temp to achieve this work should be provided to the framework. Work will be mechanical work, attraction, power and a lot of elective supply. It has outsizedly affected a few ventures, life, agribusiness and a lot of other issue. The idea nourishment safeguarding goes back to the old civilization. Be that as it may, refrigeration innovation has immediately developed inside the only remaining century, from ice reap to temperature-controlled rail vehicles. The presentation of virus rail autos added toward the westbound broadening of the us, allowing settlement in areas that weren't on primary transport channels like waterways, harbors, or discouragement trails. Settlements were conjointly creating in sterile segments of the nation, brimming with new common assets. These

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new settlement designs started the structure of tremendous urban communities that are prepared to flourish in areas that were generally thought to be aloof, similar to Houston, Texas and city, Nevada. In most created nations, urban communities are vigorously reliant upon refrigeration in grocery stores, in order to get their sustenance for day by day utilization. the ascent in nourishment sources has prompted a greater grouping of rural deals coming back from a littler offer of existing homesteads. Homesteads nowadays have a way bigger yield for each individual contrasted with the late 1800s. This has brought about new sustenance sources possible to whole populaces, that has outsizedly affected the nourishment of society.

II. LITERATURE SURVEY

James M. Quiet, has contemplated the emanation and natural effects of R11, R123, R-134a because of spillage from radiating chiller framework. He additionally examined the all out effect in type of TEWI and change in framework effectiveness or execution because of charge misfortune. He additionally outlined the methods to decrease the refrigerant misfortunes by the framework like plan alterations, improvement in preventive support procedures, utilization of cleanse framework for refrigerant vapor recuperation, adjusting and oil changing in framework. Samira Benhadid-Dib and Ahmed Benzaoui [5], have demonstrated that the employments of halogenated refrigerants are destructive for condition and the utilization of "characteristic" refrigerants become a conceivable arrangement. Here regular refrigerants are utilized as an elective answer for supplant halogenated refrigerants. The answer for the ecological effects of refrigerant gases by a gas which contains no chlorine no fluorine and does not dismiss any CO2 emanations in the climate. The scientists demonstrated that discharges effectsly affect our condition. They additionally worried by a commitment to the decrease of ozone depleting substances and by the substitution of the contaminating cooling liquids (HCFC).

Eric Granryd, has enrolled the diverse hydrocarbons as working medium in refrigeration framework. He considered the distinctive wellbeing guidelines identified with these refrigerants. He demonstrated the properties of hydrocarbons (for example no ODP and unimportant GWP) that make them intriguing refrigerating options for vitality effective and ecologically amicable. However, wellbeing safeguards because of combustibility must be truly considered.

Y. S. Lee and C. C. Su, have examined the execution of VCRS with isobutene and contrast the outcomes and R12 and R22. They utilized R600a around 150 g and set the refrigeration temperature around 4 °C and - 10 °C to keep up the circumstance of cold stockpiling and solidifying applications. They utilized 0.7 mm interior distance across and 4 to 4.5 m length of slim cylinder for cold stockpiling applications and 0.6 mm inner breadth and 4.5 to 5 m length of hairlike cylinder for solidifying applications. They saw that the COP lies somewhere in the range of 1.2 and 4.5 in cool stockpiling applications and somewhere in the range of 0.8 and 3.5 in solidifying applications. They additionally seen that the framework with two slender cylinders in parallel performs better vulnerable capacity and cooling applications, though that with a solitary cylinder is reasonable in the solidifying applications.

III. REFRIGERANT SELECTION CRITERION

1. Thermo dynamic and thermo-physical properties.
2. Environmental and safety properties
3. Economics.

IV. EXPERIMENTATION

Table.1 Refrigerant taken from the tables as possible replacement

Refrigerant	R32	R152a	R245a	Mol wt	GWP
M1	0.1	0.4	0.5	98.6	588
M2	0.1	0.5	0.4	91.8	505

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Table.2 Components specification

Components	Specifications
Compressor	Specifications of the compressor used in project are given below: • Application with R-134a • Type -Hermetically sealed compressor • Electrical circuit-CSIR • Operating voltage- 1ph, 180-260V AC • Start capacitor- 40-60 microF,@275V A Capacity- 240BTU
Condenser	• Single role forced air cool Condenser with fan.
Filter drier	Working pressure = 500psig (34.01bar) • For use with CFC, HCFC, HFC, R-134a, R12, R22, R40, R401a, R402a, R404a, R407a, R502a, R502a Refrigerants
Expansion device	• Type- capillary tube • Diameter of capillary tube is 1.0 mm. • Length of capillary tube is 2.5m
Evaporator coil	Specifications of the evaporator used in project are given below: • Diameter of copper coil is 0.6mm. • Length of copper coil is 7500mm.
Chilling tank	• Dimensions of tank – length=600mm, width=450mm, height=300mm • Insulation is done with the help of wood and thermo-col. • The thickness of wood and thermo-col are 10mm and 24.5mm
Energy meter	• Static watt hour meter • 3 Phase 4 wire energy meter • Rating- 10-40 Amp, 240V, 50Hz

V. RESULTS & DISCUSSION

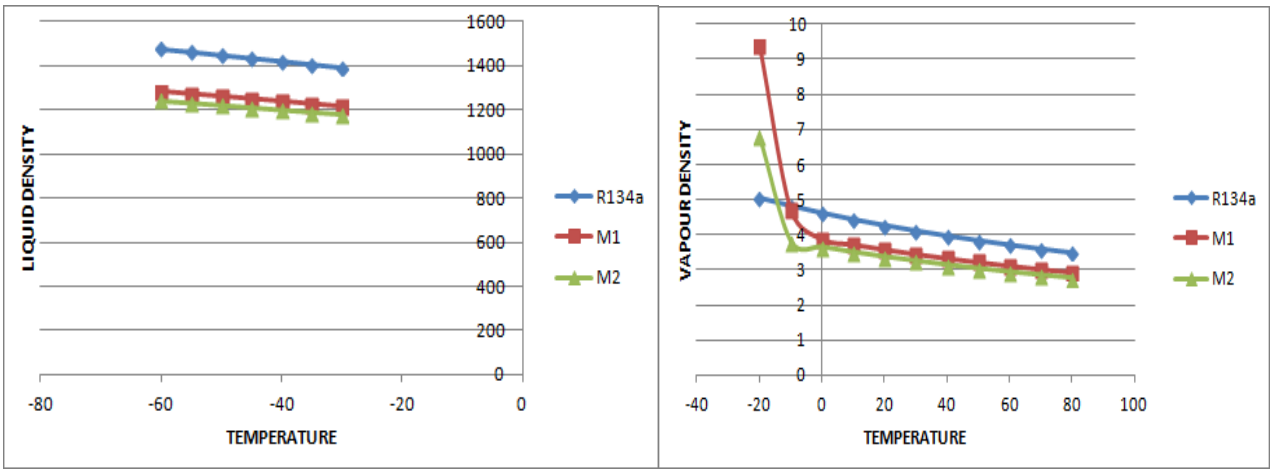

Fig.1 Liquid density vs temperature & Vapour density vs temperature

When desity is high sp.volume will be low ,which means that for a given mass storage the required size of compressor will be small .A graph is plotted between density and temperature ,showing variation of density with temperature for

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R134a ,M1 and M2. From graph it is clear that R134a has highest density , M2 has lowest density and M1 lies between M2 and R134a . Hence for a given mass storage R134a will require small size compressor.

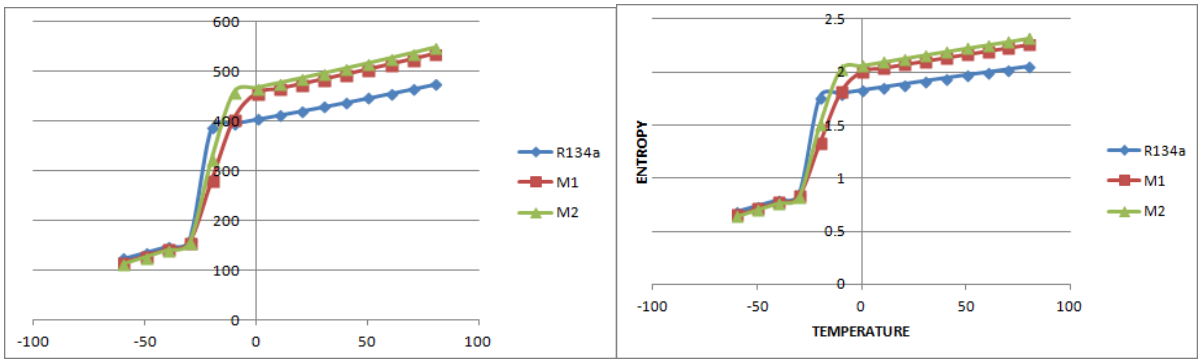

Fig. 2 Enthalpy with constant temperature & Entropy with constant temperature

Enthalpy of refrigerant is best representation of its heat extracting or absorbing capacity. More the enthalpy greater the amount of heat a particular refrigerant will extract or absorb. Enthalpy versus temperature graph is plotted for R134a, M1 and M2.It can be seen from the graph tht M2 has highest enthalpy , R134a has lowest enthalpy and M1 lies between R134a and M1. So mass of refrigerant required is less in M2 as compared to M1 and R134a.

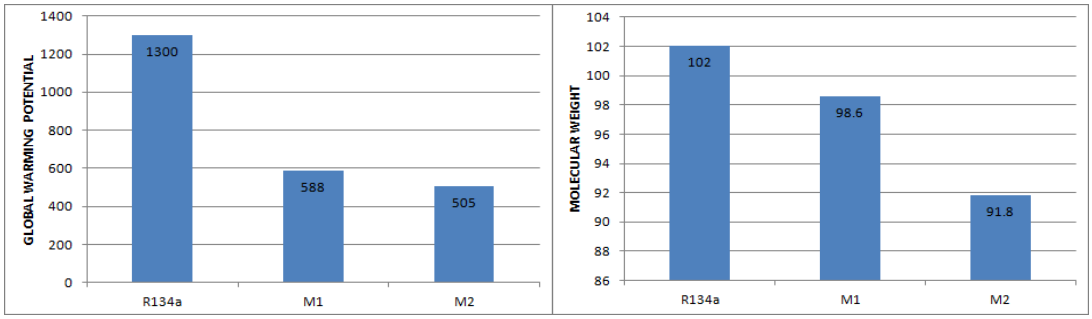

Fig. 3 Global warming potential (GWP) & Molecular weight of mixture refrigerants compared with R134a

GWP or global warming potential is a relative or comparative measure of how much heat a greenhouse gas traps or hold in the atmosphere. For GWP calculation of carbon dioxide (CO2) gas is taken as standard. It compares or consummate the amount of heat trapped or absorbed by a certain or given mass of the gas relative to the amount of heat trapped by a similar mass of carbon dioxide (CO2) gas. A column graph is plotted showing the comparison of global warming potential of R134a, M1 and M2. It can be seen from the graph that M1 and M2 has less GWP as compared to R134a. M2 has lowest GWP. While latent heat of vaporization and specific heat both these properties are very much dependent on molecular weight of refrigerant. Latent heat of vaporization will be high for refrigerant having lower molecular weight. Also higher the molecular weight lower will be specific volume hence lesser quantity of refrigerant is required to obtain the desired refrigeration effect. This is an advantage. A column graph is plotted to give a comparison between molecular weight of R134a , M1 and M2.

Table.4 Result comparision of R134a with Mix 1 and Mix 2

REFRIGERENT	R134a	M1	M2
C.O.P	5.86	6.84	6.84
Molecular weight	102	98.6	91.8
Global warming potential	1300	588	505
Ozone depleting potential	0	0	0

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VI. CONCLUSION

Available 2 refrigerant samples, M1 and M2, M2 can be taken as better replacement. Both M1 and M2 have same COP but global warming potential is less for M2. Also it has high enthalpy at both liquid and vapour stage so it has higher heat extracting and releasing capacity at evaporator and condenser respectively. Also the replacement M1 and M2 are halocarbon with which is nontoxic and non-flammable. Hence M2 can be suggested as best replacement.

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