EXAMINATION OF IMPACT ON FUME PRESSURE REFRIGERATION FRAMEWORK BY UTILIZING NANOADDITIVES MIXES REFRIGERANTS

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ABSTRACT

In India, almost 90% of the refrigeration frameworks viz., homegrown fridges, profound cooler units, food capacity gadgets use R134a as the normal working liquid. The An unnatural weather change Potential (GWP) of R134a is high of the request for 1300. Use of R134a refrigerant causes consistent consumption of ozone layer and an unnatural weather change impact. The Chloro fluoro carbon (CFC) substances harms the ozone layer of air, yet additionally bring greenhouse impact to earth and seriously influence earthly climate and human wellbeing. The Montreal and Kyoto Convention proposed limiting the utilization of green house gases alongside hydroflurocarbons (HFCs) to use as refrigerants in refrigeration framework. R134a isn't miscible with the oil of the blower unit. A portion of the European nations have restricted the use of R134a as refrigerant in fridges. The focal point of this examination is to test and lay out a reasonable option to the traditional R134a. The proposed eco-accommodating refrigerant in this work is R152a which enjoys a benefit of zero Ozone Exhausting Potential (ODP) and a huge decreased GWP worth of 140 as it were.

1. INTRODUCTION

In this examination three kinds of examinations were completed. The most normally utilized business refrigerant R134a and the demonstrated option R152a were mixed and the new crossover refrigerant was ready and the relating execution of the framework was explored. The exploratory outcomes and investigation plainly show that there is plausible of retrofitting the mix of R152a and R134a with no framework alteration. Nano additive, for example, Al2O3 were mixed with R152a refrigerant at 0.05% v, 0.1 % v and 0.15%v focus were researched. The blower attractions pressure, release pressure, fume pressure, blower input power, volumetric cooling limit and coefficient of execution (COP) were registered and broke down. A trial test rig is planned and manufactured natively in the lab to do these examinations. Nano refrigerant was found to work securely and with framework improvement.

Watchwords: blower attractions pressure, release pressure, fume pressure, blower input power, volumetric cooling limit, coefficient of execution (COP)

2. PRESENTATION

Refrigeration might be characterized as the most common way of accomplishing and keeping a temperature underneath that of the environmental factors, the point being to cool an item or space to the necessary temperature. One of the main uses of refrigeration has been the conservation of transient food items by putting away them at low temperatures. Refrigeration frameworks are additionally utilized widely for giving warm solace to people through cooling.

3. INDIAN SITUATION

The refrigeration and cooling area in India has long history from the early long periods of last 100 years. India is as of now delivering R134a, R22, R717 and hydro carbon based refrigeration and cooling units in enormous amounts. The utilization of CFC refrigerants in new frameworks was halted since the year 2002. The variables that direct the reception of a specific refrigerant separated from its reasonableness for the particular application are its accessibility and cost. The halogenated refrigerants, for example, R12, R22, R134a and normal refrigerant like R717 are promptly accessible at low costs. The Hydrocarbon (HC) and Hydro Fluro Carbon (HFC) blends (like R404a, R407, and R410A) are not at present produced natively and consequently must be imported at a greater expense. This is probably going to influence the development in refrigeration and cooling area in India and furthermore the absolute change to natural well disposed choices soon.

4. HOMEGROWN REFRIGERATION

The Indian family fridge industry is over 50 years of age. Eight significant homegrown fridge fabricates were catering this market, of which four are producing airtight blowers. Homegrown coolers produced in India range in limits from 65 to 580 l. The greater part of the at present delivered Indian coolers involves R134a as refrigerant. The decision of option in contrast to R134a is reduced to R152a and hydrocarbon refrigerants. Fridges made before 2000 were all the while running on R12. To full fill the targets of the Montreal Convention, R12 must be supplanted by either hydrocarbon combinations or R134a/hydrocarbon blends without alteration in the current framework.

5. BUSINESS AND MODERN REFRIGERATION

A large portion of business coolers like chest coolers, bottle coolers, visi coolers, show cupboards, water coolers and stroll in coolers are involving R134a and R12 as the refrigerant. Yearly creation of business refrigerated lodges (like chest coolers, show cupboards, bottle coolers and visi coolers), water coolers and stroll in coolers in India were assessed to separately be around 40,000, 27000,and 500 units. Around 80% of these units are made by little and medium ventures (Service of Climate and Timberland, 2005). The decision of reasonable option in contrast to R134a in business applications is R152a and hydrocarbon combinations. The assessed populace of milk chilling and cold stockpiling in India was around 14,000. The majority of the cool stockpiling and milk chilling plants are working on smelling salts and some on R502. Alkali will overwhelm the modern refrigeration area because of its positive climate properties (zero ODP and GWP). The elective decision for R502 is 507 and hydrocarbon blends for low temperature modern applications**.**

Forced air systems, Intensity Siphons and chillers

In India it is assessed that 1,000,000 room forced air systems is being fabricated with R22 as refrigerant each year, which compromises of window, split and bundled cooling units (Devotta etal., 2005). The limit of the windows forced air systems goes from 0.5 TR to 2 TR. The decision of option in contrast to R22 in cooling applications is R407 and R410 which are accessible in theIndian market. Yearly around 4000 focal cooling chillers were introduced, the greater part of these chillers depended on R22 and R11. Exceptionally restricted chillers were by and by introduced with R123 because of the absence of accessibility on this refrigerant. The long - term option in contrast to R11 and R22 for the chiller applications is R123**.**

6. LITERATURE SURVEY

Anarghya Ananda Murthy, Alison Subiantoro, Stuart Norris, Mitsuhiro Fukutab(2019)

[1] A Survey on Expanders and their Presentation in Fume Pressure Refrigeration Frameworks" This paper surveys progress detailed in the open writing of the utilization of expanders to recuperate development ability to further develop the energy proficiency of fume pressure refrigeration frameworks. Spearheading works in the field are first examined, and afterward an assortment of expander systems, including responding cylinder, moving cylinder, revolving vane, parchment, screw and turbine are evaluated along with their detailed exhibition.The greater part of the revealed works have been for transcritical CO_2 refrigeration frameworks, which have detailed enhancements in the coefficient of execution (COP) of up to 30%. In a non-CO_2 framework, the greatest detailed expansion in the COP was 10%.

Mohd Waheed Bhat, Gaurav Vyas, Ali Jarrar Jaffri, Raja Sekhar, Dondapati (2018) [2] "Examination on the thermo actual properties of Al_2O_3, Cu and SiC based Nano-refrigerants" The interest for energy is expanding emphatically, subsequently energy protection and decrease of emanations become necessary for reasonable turn of events.

Notwithstanding, the gigantic improvement in innovation has prompted energy lack and natural a worldwide temperature alteration. Homegrown coolers have been distinguished as colossal discharge donor all around the world because of utilization of high Ozone Exhausting and An unnatural weather change Expected Chlorine or Fluorine based refrigerants. All around the world significant sum from all out energy financial plan is consumed to run homegrown coolers chipping away at R134a refrigerant. From writing overview, it has been found that utilization of Hydrocarbon refrigerants like R290; R600a and so forth have ended up being energy effective and eco-accommodating to the climate. Additionally, utilization of nano particles in refrigerants upgrades thermo-actual properties like warm conductivity, thickness, consistency and explicit intensity, accordingly improves the presentation of refrigeration frameworks. In this review, the estimation of thermo actual properties of blended nano refrigerants have been completed utilizing NIST data set standard 4 (SUPERTRAPP®) adaptations 3.2.1 Bourhan M. Tashtoush Moh'd A. Al-Nimr Mohammad A. Khasawneh (2017)

[3] Examination of the utilization of nano-refrigerants to improve the exhibition of an ejector refrigeration framework this work, the presentation of an ejector refrigeration framework utilizing nano-refrigerants is researched. Another speculation is proposed for stream bubbling demonstrating, where nanoparticles are expected to not relocate to the fume stage as stage changes happen ceaselessly; this causes a critical expansion in nanoparticle mass portion for high fume quality qualities. This suspicion shows a sensible connection with recently distributed information for R113/CuO combinations, where a typical deviation of 9.24% was gotten. A parametric examination is performed to explore the variety in heat move coefficient (HTC) with temperature, nanoparticle type, size, and mass portion. At last, the impact of nanoparticles on thecoefficient of execution (COP) of the ejector refrigeration cycle as a reaction to the increased stream bubbling HTC is examined by reenacting a 5-kW cooling refrigeration cycle. Taking into account the upside of utilizing nano-refrigerants, a greater fume was accomplished at the evaporator exit, bringing about an

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expansion in the enthalpy contrast in the evaporator in the ejector cooling cycle. Jiaheng Chen, JianlinYu, GangYan (2016) [4] "Execution examination of a changed autocascade refrigeration cycle with an extra dissipating subcooler" An adjusted autocascade refrigeration cycle with an extra vanishing subcooler is proposed, which can take advantage of the temperature coast normal for zeotropic blends. The energy and exergy execution correlation between the changed cycle and an essential auto overflow refrigeration cycle utilizing the zeotropic combination of R23/R134a is done by the reenactment strategy. Aklilu Tesfamichael Baheta, Suhaimi Hassana, Allya Radzihan Reduana, (2015) [5] the goal of this paper is to research the exhibition of a transcritical CO2 pressure refrigeration cycle for various boundaries and assess its COP. That's what to accomplish, a refrigeration cycle was demonstrated utilizing thermodynamic ideas. Then, the model was reproduced for different boundaries that were controlled to research the cycle execution. Keeping up with other working boundaries steady the most elevated COP was 3.24 at 10MPa gas cooler tension. It was additionally seen that the cycle is appropriate for cool application than refrigeration cycle, as COP increments when the evaporator temperature increments. Recreations were directed utilizing Succeed created program. The outcomes can be utilized in the plan of CO2 refrigeration cycle.

Q. W. Pan, R. Z. Wang, Z. S. LuL., W. Wang (2014) [6] "Exploratory examination of an adsorption refrigeration model with the functioning sets of composite adsorbent-smelling salts" A 4-valve adsorption refrigeration model, which uses the composite adsorbent of calcium chloride/enacted carbon and the refrigerant of smelling salts, is created and tried. Framework dependability is fundamentally improved on the grounds that the coordinated adsorbers are embraced, the shut dissemination for warming and cooling processes is planned, and the framework activity is enhanced. Tests demonstrated the way that the model can begin rapidly, and the activity of the framework is truly steady. The impacts of mass recuperation time, process duration, warming temperature, dissipating temperature and cooling water temperature on framework execution have been contemplated.

Michael S. Saterile et al. (2013) [7] concentrated on the power agglomeration and warm conductivity in copper-based nanofluids. After cautious assurance of morphology and virtue, they deliberately and thoroughly looked at every one of the three of the surfactants for the development of reasonable copper-based nano liquids during blend of copper nano powders has significant results on the scattering of the powders in a base liquid. The oleicacid-arranged powders comprised of little particles of ~ 100nm that didn't change with expansion of dispersant.

Abhishek Tiwari et al. (2012) [8] directed on trial investigation of R404a and R134a, climate amicable refrigerants with zero ozone consumption potential (ODP) and low an Earth-wide temperature boost potential (GWP), to supplant R134a in homegrown cooler. A cooler planned and created to work with R134a was tried, and its exhibition utilizing R404a was assessed and contrasted and its presentation when R134a was utilized. The outcomes got showed that the plan temperature and pulldown time set by Global Standard Association (ISO) for little fridge were accomplished before utilizing refrigerant R-401a than utilizing R-134a.

The framework consumed less energy when R134a was utilized. The presentation of R404a in the homegrown cooler was continually better compared to those of R134a all through every one of the working circumstances, which demonstrates the way that R404a can be utilized as swap for R134a in homegrown fridge.

7. EXPERIMENTAL SET UP

FABRICATION OF EXPERIMENTAL SETUP

The experimental consists of a compressor, fan cooled condenser, expansion device and an evaporator section as shown in Fig. 5.1 and 5.2. Capillary tube is used as an expansion device. The evaporator is of serpentine coil type which is loaded with water. Service ports are provided at the inlet of expansion device and compressor for charging the refrigerant. The mass flow rate is measured with the help of flow meter fitted in the line between expansion device and drier unit. The experimental setup was placed on a platform in a constant room temperature. The ambient temperature was ±1.5°C. The air flow velocity was found to be less than 0.25m/s.

MEASUREMENT OF PARAMETERS

The temperatures at different parts of the experimental setup are measured using resistance thermocouples. 8 numbers of resistance thermocouples were used for the experimentation. The pressures at compressor suction, discharge, condenser outlet and at evaporator outlet are measured with the help of pressure gauges. The power consumption of the system was measures by a digital Watt- hr meter. A digital wattmeter and flow meter were also connected with the experimental setup.

Table 3.1 summarized the characteristics of the instrumentation.

Variable	Device	Range
Temperature	Pt100 PID controller	50 to 199°C
Pressure	Pressure Gauge	0-10 bar
Power	Digital Watt/Watt-h meter	5-20A
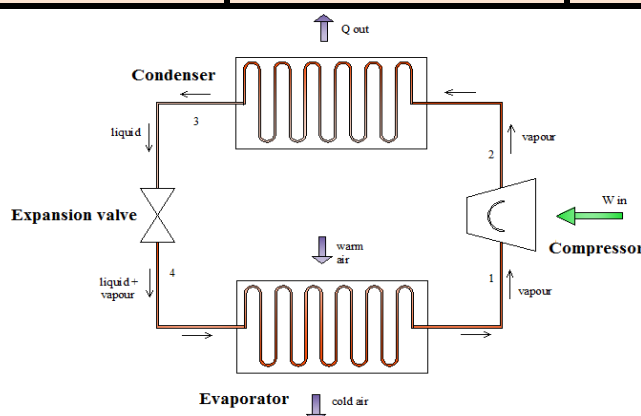
8. CALCULATIONS USED BY SOFTWARE

Calculations:

From the pressure measuring device only gauge pressure is measured convertthat into absolute pressure.

Absolute pressure = gauge pressure + atmospheric pressure.

$P_{abs} = P_{gauge} + P_{atm}$

1) **Refrigeration effect**

   The amount of heat taken by the refrigerant in the evaporator is called refrigerant effect.

   Refrigerant effect = m_w cp (dT) (1.1)

2) **Actual C.O.P**

   It is the ratio of refrigerant effect to the power consumed by

   the compressor. C.O.P actual = h_1-(1.2) h_2 - h_1

3) **Capacity of VCR system (TR)** = Refrigerant Effect/min (1.3) 210

4) **Mass flow rate (ṁ) kg/s** = Refrigerant Effect/s (1.4) h_1 −h_4

5) **Power consumption by the compressor (P)** = volts *amps (V*I) (j/s) (1.5).

6) **Energy input o the compressor** = Power *Time = p*t (kj) (1.6)

9. RESULTS AND DISCUSSION

This chapter deals with the experimental procedure adopted, relevant parameters during the course of the present investigation. In developing country like India, most of the vapour compression based refrigeration, air conditioning and heat pump systems continue to run on halogenated refrigerants due to its excellent thermodynamic and thermo-physical properties apart from the low cost. However, the halogenated refrigerants have adverse environmental

impacts such as ozone depletion potential (ODP) and global warming potential (GWP). Hence it is necessary to look for alternatives refrigerants to full fill the objectives of the international protocols (Montreal and Kyoto) and to satisfy the growing worldwide demand.

BLENDING OF R152a AND R134a- The system was charged with the help of charging system and evacuated with the help of vacuum pump to remove the moisture. After charging each refrigerant, data were collected and different evaporator temperatures using equation 3.1 to 3.7. The following parameters were obtained using the above equations. a) vapour pressure b) compressor input power c) co-efficient of performance d) volumetric cooling capacity and e) pressure ratio. Initially a performance test is made with the system loaded with pure R134a. The data is treated as the basis for the comparison with the refrigerant mixtures. The mixture composed of R152a and R134a was considered as an alternative to R134a. This mixture is further referred in this work as HCM. Blend mixtures HCM of R152a and R134a by mass in the proportion of HCM 30:70 (30% weight of R152a and 70% weight of R134a), HCM 50:50 (50% weight of R152a and 50% weight of R134a) and HCM 70:30 (70% weight of R152a and 30% weight of R134a) were charged through the charging port in the compressor and the performance tests were conducted. The results of the performance comparison of the investigated mixture of the refrigerants (R152a and R134a) in the vapour compression refrigeration system are given below.
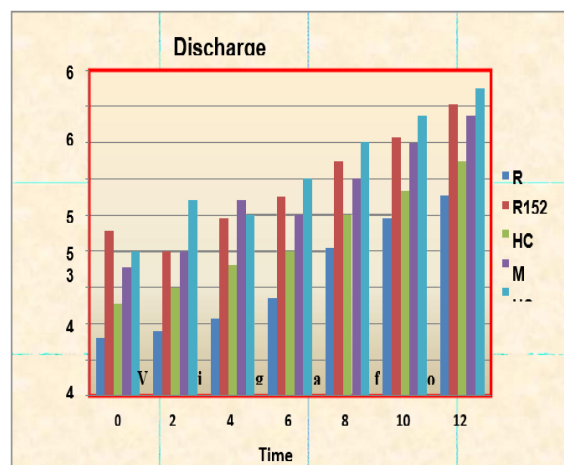
10. VARIATION OF DISCHARGE TEMPERATURE

Blend mixtures HCM of R152a and R134a by mass in the proportion of HCM 30:70 (30% weight of R152a and 70% weight of R134a), HCM 50:50 (50% weight of R152a and 50% weight of R134a) and HCM 70:30 (70% weight of R152a and 30% weight of R134a) were charged through the charging port in the compressor and the performance tests were conducted. The results of the performance comparison of the investigated mixture of the refrigerants (R152a and R134a) in the vapour compression refrigeration system are given below.

Fig.4.1 Ariation Dischar Temper Ure A Unction Time

VARIATION OF DISCHARGE PRESSURE

Fig.4.2 shows that the discharge pressure decreases with the variation in time. The discharge pressure was recorded to be highest for R152a followed by HCM 70:30, HCM 50:50 and HCM 70:30. The discharge pressure was found to be lowest for pure R134a
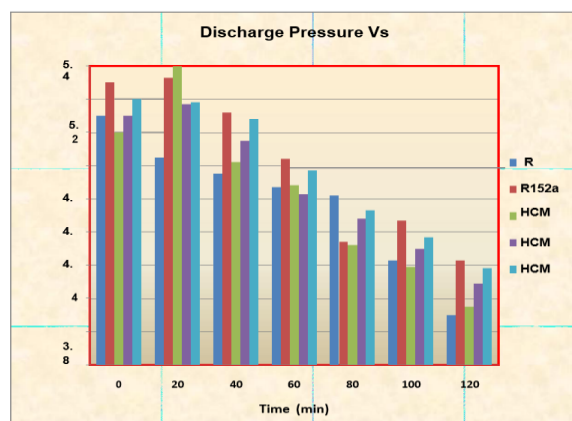

Fig. 4.2 Variation in discharge pressure as a function of timeVariety OF Release Strain

The variety of immersion strain of an element of evaporator temperature for three refrigerant combinations is displayed in Fig.4.3. R152a as most reduced pressure and R134a recorded the most elevated pressure. The HCM 70:30 recorded the most reduced tension among the three combinations. Refrigerant with low strain is positive in the framework in light of the fact that the higher the tension the heavier should be the hardware parts and frill. Utilization of R152a inferable from the least fume pressure diminishes the weight of the different parts of the refrigeration framework
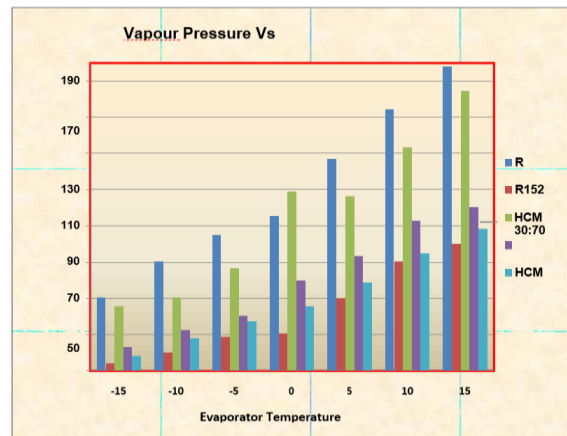

Fig. 4.3 Variation of vapour pressure with varying evaporator temperaturefor R152a, HCM mixtures and R134a
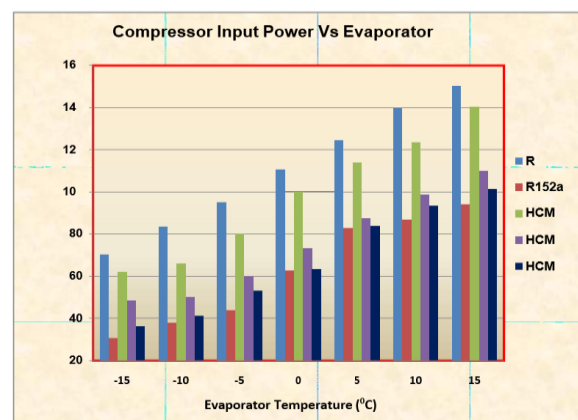

Fig. 4.4 Variation of Compressor input power with varying evaporator temperature for R152a, HCM mixtures and R134a

11. CONCLUSION

An experimental study was conducted in chapter 6 with the blend of R152a and R134a in vapour compression refrigeration system. Based on the present investigation, the following specific conclusions could be drawn.

❖ The discharge temperature and the discharge pressure of the compressor were found to be lowest for HCM 70:30 when compared with other mixtures.

❖ HCM 70:30 recorded the lowest vapour pressure among the mixtures which reduces the heaviness of the components of the refrigeration system byusing this blend.

❖ The average pressure ratio for HCM 70:30 was lowest with the value of which promises the life extension of the compressor.

❖ The average input power to the compressor for HCM 70:30 was found to be 9.5% lower than R134a. Usage of this blend reduces the power consumptionof the system.

❖ The heat removal rate was higher for HCM 70:30.

❖ Higher volumetric capacity of 4.9% higher for HCM 70:30 was observed when compared to other blends of refrigerants. This ensures increasing coolingeffect for the same size of the compressor as used for pure R134a.

❖ Highest COP value of was obtained for HCM mixture 70:30.

❖ The system works safely with the replacement of R152a blend with theconventionally used R134a.

❖ No system modification was done for the retrofitting process which is amajor advantage of the present research.

❖ Addition of nano additives with R152a decreases the vapour pressure ofthe refrigerant. Nano refrigerant with low

vapour pressure will desirable the system as it reduces the weight of the components of the system and its accessories. The vapour pressure of 0.1% CuO was found to be lowest with the mean pressure of 7.23% lower than pure R152a.

❖ The pressure ratio decreases with the addition of nano additives. The average lowest pressure was 3.6 for 0.1% CuO which 12.3% lower than 0.5% CuO. Decrease in pressure ratio improves the life of the compressor.

❖ The compressor vapour pressure was found to decrease on the addition of nano additives .the aveage compressor input powrr for 0.1% cuo was 9.5% lower than the other concentration and other nano additives.This value is 23.7% lesser than pure R152a refrigerant.

❖ Increase in evaporation temperature due to the increase in cooling capacity improves the COP of the system with the reduction in power consumption of the compressor. The COP of 0.1% of CuO is found to be highest among the other nano additives. The decreasing order of nano additives on the basis of COP can be given as CuO, Al2O3 and ZnO. Thus the usage of 0.1% CuO nano additive with R152a which haslow GDP value of 140 and zero ODP ensures safe and clean environment with less power consumption.

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