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"A REVIEW ON UNWANTED WEATHER CHANGE CAPABILITY OF R134A IS C1 AND C2"

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ABSTRACT

An analysis of the R134a (tetrafluoroetane) coolant's non-stationary behavior in rectangular microchannels was conducted with the help of a newly proposed miniature refrigerating machine of our own design and construction. The experimental device incorporated, on the same plate, a condenser, a lamination tube and a vaporizer, all of which integrated rectangular microchannels. The size of the rectangular microchannels was determined by laser profilometry. R-134a coolant vapors were pressurized using a small ASPEN rotary compressor. Nano refrigerants, which involve the combination of refrigerants with nanoparticles, serve to enhance the refrigeration process. Studies have demonstrated that when compared to conventional refrigerants, the introduction of nanoparticles significantly enhances heat transfer capabilities.

Key Words: *R134a, Nano refrigerant, design, coolant.*

I. INTRODUCTION

1.1. Introduction

Refrigeration is a crucial technology that plays a significant role in modern life, impacting various industries, households, and the global economy. It is the process of cooling or maintaining low temperatures in a controlled environment, typically used to preserve perishable goods, create comfortable living conditions, and support various industrial processes. Here are some key aspects of refrigeration:

1.1.1. Working Principle

Refrigeration systems operate based on the principles of heat transfer. They utilize a refrigerant, which undergoes a cycle of compression, condensation, expansion, and evaporation to absorb heat from one location and release it in another.

1.1.2. Applications

- **Food Preservation:** Refrigeration is widely employed in the food industry to extend the shelf life of perishable items like fruits, vegetables, dairy products, and meat.
- **Air Conditioning:** It is a fundamental component of air conditioning systems, helping maintain comfortable indoor temperatures in homes, offices, and vehicles.
- **Medical and Pharmaceutical:** Refrigeration is crucial for preserving vaccines, medications, and medical samples that require precise temperature control.
- **Industrial Processes:** Many industrial processes, such as chemical manufacturing and electronics production, rely on refrigeration to maintain specific temperature ranges.

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- **Transportation:** Refrigerated trucks and containers are used to transport temperature-sensitive goods over long distances.
- **Energy Efficiency:** Advances in technology, such as variable-speed compressors and heat exchangers, have contributed to more efficient refrigeration systems.

1.2. Ways of Refrigeration

- Non-cyclic refrigeration
- Cyclic refrigeration
- Thermo-electrical refrigeration
- Magnetic refrigeration

Cyclic refrigeration is often sub-divided into:

- Vapor cycle refrigeration
- Gas cycle refrigeration

Vapor cycle refrigeration is classified as:

- Vapor compression refrigeration
- Vapor absorption refrigeration

1.3. Non-Cyclic Refrigeration

Refrigeration can be achieved through non-cyclic methods such as melting ice or subliming dry ice (solid carbon dioxide). These methods are used for small-scale refrigeration applications like in laboratories, workshops, or portable coolers.

Ice is an effective refrigerant due to its constant melting point of 0°C (32°F). To melt, ice must absorb a significant amount of heat. Maintaining food and other perishables at this temperature or slightly above helps extend their storage life.

Solid carbon dioxide, also known as dry ice, quickly transitions from a solid to a vapor phase at a temperature of -78.5°C (-109.3°F). This property makes it effective for maintaining products at low temperatures during the sublimation process. In this type of total loss refrigeration, the cooling agent evaporates and is vented into the surrounding space.

1.4. Vapor Compression Refrigeration System

It employs a refrigerant that is sealed within a leak-proof mechanism. This refrigerant circulates through the system and undergoes various state changes as it passes through the different components. Each change in the refrigerant's state is referred to as a process. The repetition of the same sequence of processes is known as a cycle.

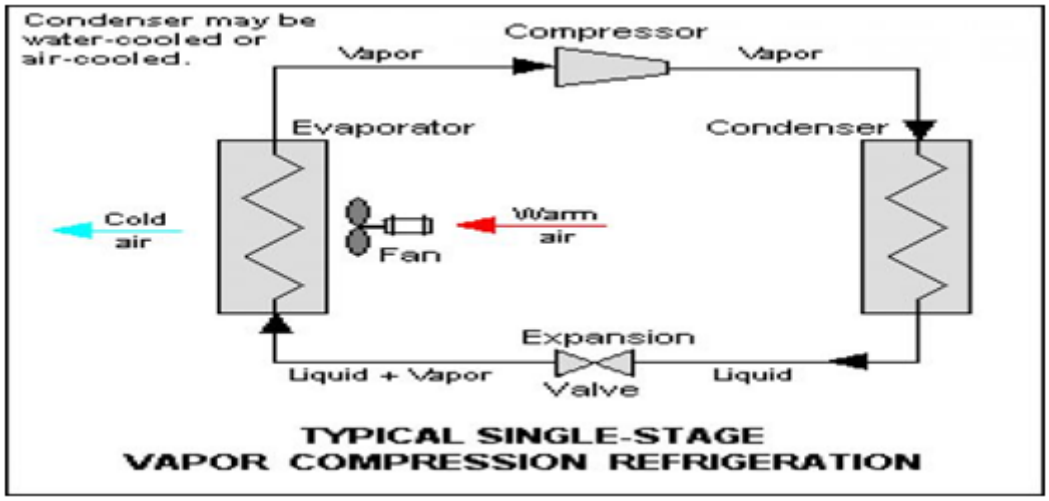

Figure 1 : Typical Single-Stage Vapor Compression Refrigeration [1]

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Here in this system a suitable refrigerant is circulated through the system which takes the heat during evaporation and release it to the atmosphere during condensation. Compressor lift he refrigerant from evaporator pressure to the condenser pressure while an expansion device is used to bring back the refrigerant to the evaporator pressure thus completing the refrigeration cycle. Various types of refrigerants are available now a days. Coefficient of performance – it's the ratio of desired result and work equipped. According to it diagram theoretical COP is calculated as:

$COP_{(Thermal)}$ = Desired effect/Work done

$$COP = \frac{h_1 - h_4}{h_2 - h_1}$$

II. Literature Review

Xiao et al. (2023) China utilizes a great deal of air source heat siphon water warmers (ASHPWHs), which are compelling and ok for the climate. This study proposes supplanting R134a in ASHPWH with a refrigerant combination of R290/R600a/R13I1, which has no ozone exhaustion potential (ODP) and a low an unnatural weather change potential (GWP). An ASHPWH hypothetical model is made utilizing MABLAB and an association with REFPROP. To investigate the reasonability of replacement. Also, the release temperature appears to be legit. As a result, the suggested mixture can be utilized in place of R134a. The ASHPWH that makes use of the suggested mixture clearly benefits when the outside temperature is extremely low. The recommended combination has a yearly typical COP of 4.65, which is roughly 6.2% higher than R134a. Also, there is a 18.99% decrease in the complete identical warming effect (TEWI). [1]

Zhao et al. (2023) In request to analyze the best COP, volumetric refrigerating limit, and irreversibility dispersion at the virus space temperature of - 45 °C to - 25 °C, thermodynamic investigations and hypothetical reenactments of the Linde-Hampson refrigeration framework utilizing a few harmless to the ecosystem zeotropic refrigerants are done. Examinations between the Linde-Hampson framework with proper blended refrigerants and the R744 two-stage pressure trans critical refrigeration framework and the fountain refrigeration framework utilizing R744 and R1234yf uncover that the Linde-Hampson framework can accomplish the most noteworthy COP and can be thought about as an enhancement and option. The review discoveries will act as an aide for the Linde-Hampson refrigeration framework's applications using ecologically satisfactory zeotropic refrigerants for the freezing system while taking proficiency, wellbeing, and natural insurance into account.[2]

Shankar et al. (2021) This work looks at the warm examination of a fume pressure refrigeration framework with nanofluids in light of Al2O3-Water in the optional circuit and R134a in the essential circuit. The examination offers subtleties on the optional liquids input conditions, the blower power utilization and the general energy execution of the framework, the exhibition boundaries of the fume pressure refrigeration framework utilizing eco-accommodating refrigerants and without nanomaterials, the effect of the by and large evaporator heat move coefficient utilizing different nanoparticles blended in with R718 in the auxiliary evaporator circuit and R134a in the essential circuit. Looking at the warm exhibition of different nano-molecule based nano liquids (like Al2O3 and TiO2) as an optional liquid in a fume pressure refrigeration framework can be achieved effortlessly by utilizing a designing condition solver programming (EES) device.[3]

Kurien et al. (2021) In late years, inactive cooling methods — which are utilized to hold hardware back from overheating and keep up with ideal execution — stand out enough to be noticed. Due to the difficulty of finding eco-friendly and effective heat transfer fluids. The thermosiphon was put upward upstanding and the warming component's feedback range was continuously extended from 20 W to 140 W. The ideal fill proportion that would well affect the thermosiphon heat line's exhibition was tracked down through trial and error. The discoveries infer that the gadget's

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opposition was at its most minimal when it was accused of a half working liquid fill proportion. Most extreme opposition decreases of 9% and 13% were accomplished when the thermosiphon's ideal fill proportion was used.[4]

Bolaji et al. (2020) Working fluids in residential refrigeration systems must have GWPs of less than 150, as required by regulations. Thus, the exhibition of five novel refrigerant blends (R440A, R441A, R444A, R445A, and R451A) with zero ODP and GWPs of under 150 was hypothetically analyzed in this work. All of the refrigerants compared to R134a had extremely low-pressure ratios and discharge temperatures, with R451A and R440A having average discharge temperatures that were 7 percent and 8 percent lower than R134a. The fume explicit volume and strain temperature properties of R451A and R440A are similar to those of R134a, showing that they can be utilized in R134a's place. R441A and R445A performed poorly across all of the performance criteria that were looked at, but R440A and R451A performed better than R134a in every way. As well as being combustible and requiring adherence to somewhere safe precautionary measures while utilizing them, these two refrigerants can be utilized as long haul, earth harmless trades for R134a in private fridges. [5]

Kasaeian et al (2018) Using harmless to the ecosystem refrigerants might be a reasonable method for combatting an unnatural weather change. However, a thorough evaluation is required when selecting new refrigerants. Any material ought to be evaluated for cost-viability, security, energy effectiveness, and absolute impact on the climate around the world. This study analyzes the hypothetical and exploratory examination done on eco-accommodating refrigerants, including hydrocarbons, hydrofluorocarbons, carbon dioxide (R744), hydrofluoroolefins, and nano-refrigerants. The primary goals of this article are to discuss the primary applications of environmentally friendly refrigerants and nano-refrigerants and to assess the potential of all of the refrigerants used in the refrigeration and air conditioning industries. The study not only identifies inconsistencies in the existing body of knowledge, but it also suggests possible directions for future research.[6]

Grabowska, K.,et al. (2018). As an alternative to R22 is described in this study, a PC code has been created with NIST REFPROP 7.0 for the relative examination of thermo-actual properties and refrigerant execution of this new blend and of R22. A drop-in trial of this new combination was acted in a homegrown climate control system initially intended for R22. Both the estimation and trial results demonstrated the way that this new blend could be viewed as a most probable drop-in substitute for R22 in numerous applications. Using an explosion apparatus, the flammability of this ternary blend was also investigated to demonstrate its safety. Additionally, reproduction of the refrigerant cycle spillage showed that the variety of organization because of spillage was practically nothing to such an extent that there is no much exhibition corruption. [7]

Shaik et al. (2017) examined the theoretical thermodynamic performance of a 0.8 TR window air conditioner using 10 binary refrigerant combinations, including propylene (R1270) and propane (R290), based on an actual vapour compression refrigeration cycle. Any refrigerant mixture under investigation has no ozone depletion potential. R22 has an unnatural weather change capability of 1760, yet every one of the explored refrigerant blends had GWPs of under three. These mixes additionally had temperature coasts of 0.4oC, putting them closer to the azeotropic range. The refrigerant mixes' all's thermodynamic exhibitions are determined under ARI conditions, with the vanishing and consolidating temperatures being 7.2oC and 54.4oC, individually. The refrigerant mixture R1270/R290 (75/25 by mass percentage) had the lowest power requirement per ton of refrigeration out of the ten that were investigated. Refrigerant blends have predominant miscibility in with mineral grease oil since they are made out of hydrocarbons. R1270/R290, a 75/25 mass percent refrigerant mixture, performed almost identically to R22 in terms of thermodynamics. [7]

III. METHODOLOGY

Experimentation setup

The overall refrigeration cycle involves the compression of refrigerant, rejection of heat in the condenser, expansion through the expansion valve, absorption of heat in the evaporator, and then the cycle repeats. The addition of a brine tank and a drier enhances the efficiency and reliability of the system by addressing specific needs related to heat transfer and moisture control.

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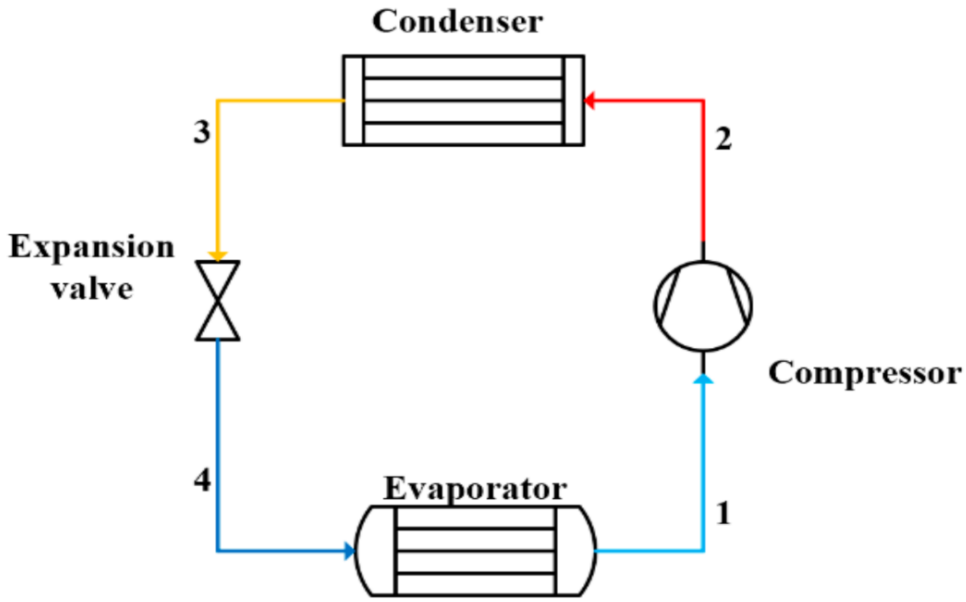

Figure 2 Line diagram of refrigeration cycle used in ice plant

IV. CONCLUSION

In conclusion, the interplay of factors such as density, enthalpy, entropy with respect to temperature, enhanced GWP and reduced molecular weight highlights the intricate relationship between these thermodynamic properties and their implications for various applications

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