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A study on low temperature Cascade Refrigeration system R134a-R404A and with R134a-R744 Refrigerant.

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ABSTRACT: A study of a low temperature system with dissimilar refrigerant pair is overviewed. R744 is used in Lower side (LST) cycle whereas R134a, and R404A are used in the Higher side (HTS) cycle. This paper present the study of refrigerant pair which is most provide cooling effect. The effects of the sub cooling, superheating, evaporating, on the low temperature system are calculated with an objective to observe the better result based on cooling effect. Refrigerant pair is selected based on minimum environmental effect and low ODP . A result is also calculated by working pair by varying constraints like sub cooling, superheating, evaporating, condensing temperature and temperature difference in the low temperature condenser of the system. The main purpose is to suggest best working pair to maintain low temperature in system.

KEYWORDS: Low temperature system, ODP, cooling effect, environmental effect.

I. INTRODUCTION

In low temperature Cascade Refrigeration system single-stage two individually operated refrigeration systems are used to maintain low temperature. In this system number of thermodynamic cycle are used. Low temperature Cascade Refrigeration system is useful for manufacturing of dry ice, storage of liquid fuel and formation of liquefied gases.

In this system, Tetrafluoroethane (R-134a) is used as a refrigerant because it is a HFC refrigerant with minor ozone depletion and also azeotropic mixed refrigerant (R404A) is used because it is similar to Freon refrigerant. Carbon dioxide (CO2) used as refrigerant because it is a natural substance that can be useful as a working fluid because of its good thermal conductor properties.

In a low temperature system, two or more vapour-compression cycles with dissimilar refrigerants are used. The temperatures of every cycle are serially reduced with some overlap to cover the total fall temperature chosen; particular refrigerants are used for efficient working and to maintain desired lower temperature. The low temperature arrangement eliminates heat from the space to be cooled using an evaporator, and transfers it to a heat exchanger that is cooled by the evaporation of the refrigerant of the high temperature end. Alternatively, a liquid to fluid or similar heat exchanger may be used in its place. The high temperature system transfers heat to a conventional condenser that carries the entire heat output of the system and may be inactively.

The high temperature refrigerant condenses in the air condenser and is then separated and evaporated to cool the heat exchanger which condenses the low temperature refrigerant.

Low temperature cycles might be detached by either being sealed in separated loops, or in self-cascade where the gases are compressed as a blend but divided as one refrigerant condenses into a liquid while the other remains as a gas throughout the system. Even though an self-cascade leads several constraints on the design and operating conditions of the system that may decrease the effectiveness it is frequently used in small systems due to only needful a single compressor, as it decreases the necessity for high efficiency heat exchangers to avoid the compressors leaking heat into the cryogenic cycles. Such types can be used in the same system, generally with the distinct cycles being the first stage(s) and the self-cascade being the last stage.

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II. METHODOLOGY

Theoretical work :

1. Detailed literature review
2. Study properties of different refrigerants.

III. EXPERIMENTATION

Design and Development work:

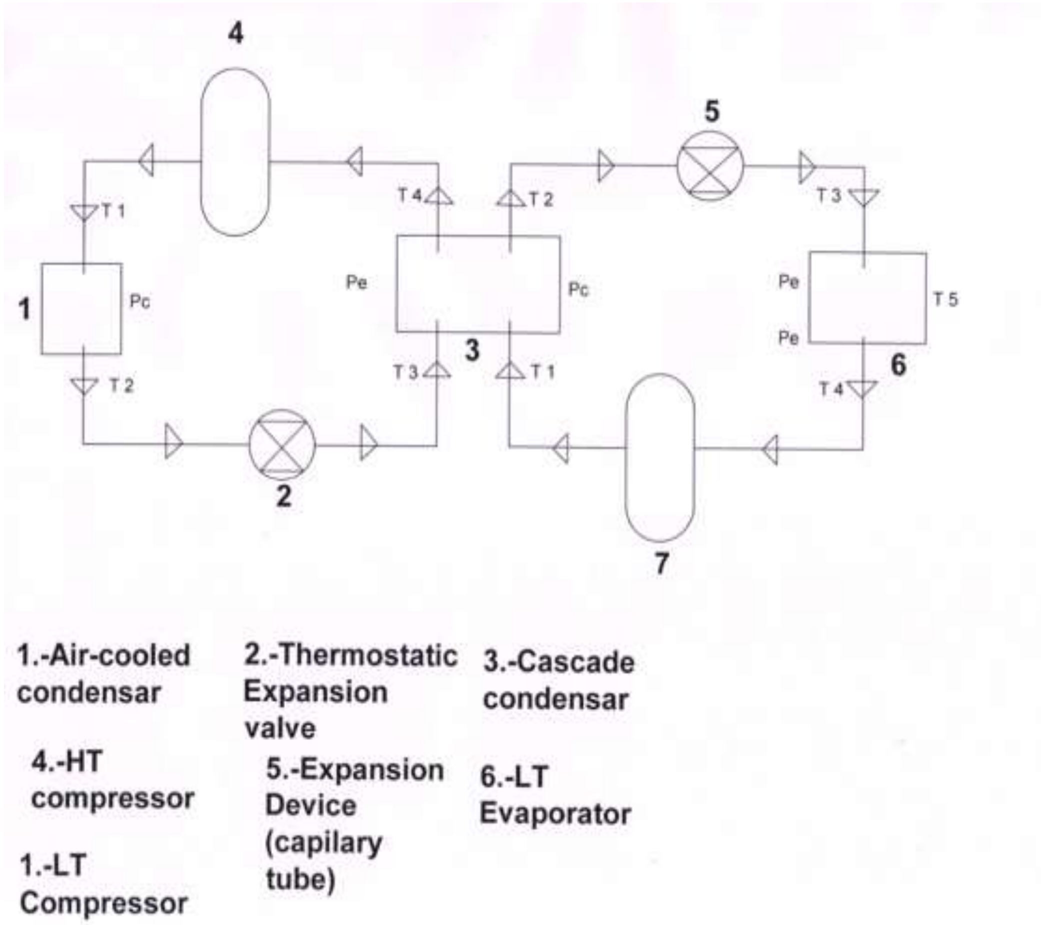
1. Selection of refrigerant couple is built on thermodynamic and ecological performance for

3.Study different methods for increasing performance for low temperature refrigeration system.

proposed work

2. Selection of condenser, evaporator, expansion valve, and compressor.
3. Design and development of experimental setup.

Experimental work:



IV. OBESERVATIONS

1. Development of theoretical model to validate the main objective of this paper is to evaluate and discover the greatest working pair for a low temperature refrigeration system.
2. Development and study of experimental setup.
3. To compare the performance of refrigeration cycle for R404a-R134a and R7444-R134a
4. Conduct the trial on low temperature refrigeration system.
5. Compare the performance of R134a-R744 and R134a-R404A refrigerant pair for refrigeration system.

A software has been established to discover the effect of parameter on the performance of a System. The parameters assumed for the computation of results are given below.

a. ETE = -60˚C ETE- Low sequence evaporating temperature
b. LTC = 0 ˚ C LTC- Low sequence condensing temperature
c. HTC =40˚C HTC-High series abbreviating temperature

d. CΔT = 3.0ºC
CΔT- difference in condenser Temperature
e. ST sup = 0ºC in both HT and LT ST sup-Degree of superheating
f. CT sub = 0ºC in both HT and LT cycle. CT sub- Degree of sub cooling,

V. CONCLUSION

The low temperature refrigerant couple R134a-R744 has higher performance as compared to R134a-R404A . The performance of system is increased with increase in superheat temperature. R134a-R744 gives maximum performance with increase in isentropic performance of compressor.

REFERENCES

[1]. Prekh A.D., Tailor P.R., 2012."Thermodynamic Analysis R507A-R23 Cascade Refrigeration System." In: International journal of Aerospace and Mechanical Engineering 6:1 2012.
[2]. A.Mr.Hiren A. Shah, B. Dr. Ragesh G. Kapadia Comparative Assessment of a Cascade refrigeration cycle with different refrigerant pair. Institute of Technology, Nirma University, Ahmedabad – 382 481, 08-10 December, 2011
[3]. Devanshu Pyasi,R.C.Gupta,"Performance analysis of 404a/508b Cascade Refrigeration cycle for low temperature" , International Journal of Engineering Science and Technology,ISSN;0975-5462,VOL.3 No.8 August 2011
[4]. Arash Soleimani Karimabad, 'Experimental investigation of C02- NH3 cascade and transcritical C02 refrigeration system in super market" by Manustai Likitthammanit, Royal Institute of Technology, Stockholm,Sweeden, 2006.
[5]. Horst KRUSE1, Rainer JAKOBS²*, Marcello RIVA³ European Supermarket Refrigeration Systems Eco-Efficiency Considerations International Refrigeration and Air Conditioning Conference 2006
[6]. Thermodynamics analysis and comparison on low temperature C02-NH3 cascade refrigeration cycle is research paper published by Tianjin University, China
[7]. American Society Heating Refrigeration and Air Conditioning. ASHRAE Hand Book. 2001
[8]. Arora, C.P. Refrigeration and Air Conditioning. Second edition. Tata McGraw-Hill Publishing Company Ltd. 2000.
[9]. W.F. Stocker, Refrigeration and Air Conditioning. Second edition. Tata McGraw-Hill
[10]. G.F. Hundy, Refrigeration and Air Conditioning. Fourth edition.

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