

Design and analysis of vapour absorption refrigeration system using R-134a and Dimethylformamide (DMF)

Mr. Pratik G. Gajare¹, Prof. S. Mitkari² Prof. Akshay Nighot³

¹ Department of Mechanical Engineering, M.Tech. Student of G.H.R.C.E.M. Wagholi, Pune

² Professor, Dept. of Mechanical Engineering, G.H.R.C.E.M. Wagholi, Pune, Maharashtra, INDIA

³ Professor, Dept. of Mechanical Engineering,, P G M C O E Wagholi Pune, Maharashtra, INDIA

Abstract - The Refrigeration by mechanical vapor pressure method is an effective technique. But, the vitality input is the shaft work, which is a high – grade vitality (One that can be effectively changed over to different structures) and hence extravagant. What's more, the work required is generally substantial in view of pressure of the vapors which experience expansive changes in explicit volumes. In the event that equivalent gas is accessible in fluid structure, to motor that to higher weight, the vitality required is less. Henceforth so as to accomplish this, the method planned is called Absorption Refrigeration method, in which the refrigerant vapor is broken up in an idle fluid at indistinguishable weight from the evaporator and the arrangement so shaped is pumped to a holder at condenser weight. This fluid which is for all intents and purposes incompressible and experiences next to no change, in explicit volume, requires almost no work in raising its weight. Absorber is one of the important components in VARS. In an absorber, low temperature and low pressure refrigerant vapor from evaporator enters the absorber and is absorbed by weak solution. Heat of absorption is rejected to an external heat sink and weak refrigerant solution converted to strong solution. Best mixture of the two refrigerants gives the maximum COP and optimum solution on today's problems.

Key Words: DMF, R-134a, refrigeration, plate heat exchanger.

1. INTRODUCTION

The effectiveness of retention refrigeration system could be expanded by keeping up a little weight contrast between the low weight and high weight side. Likewise, cyclic effectiveness of this system to a great extent rely upon the thermodynamic properties of the chose refrigerant-retentive matches just as working conditions. In this way, a wide investigation of the properties of chose refrigerant-permeable matches just as working conditions is of most extreme significance

in the advancement of a proficient assimilation refrigeration cycle.

The vapor retention system utilizes poor quality warm vitality and has turned into an alluring alternative for cooling. This specific inclination to be worked with poor quality vitality includes an advantage against the regular vapor pressure system which keeps running with high evaluation electrical vitality. The assimilation refrigeration system likewise has some more advantages, for example, quiet capacity, high reliability, long administration life, basic limit control, simpler execution, low upkeep and furthermore does not require any moving part aside from a little arrangement siphon. The fundamental constitution of a vapor assimilation system incorporates an evaporator, a safeguard (low weight side), a generator and a condenser (on high weight side). The focus and condition of refrigerant in every one of the parts is unique.

2. METHODS OF REFRIGERATION

- Non-Cyclic Refrigeration
- Cyclic Refrigeration
 - Vapour Compression Refrigeration
 - Vapour absorption Refrigeration
 - Gas cycle
- Thermoelectric Refrigeration
- Magnetic Refrigeration
- Ice refrigeration
- Evaporative refrigeration
- Refrigeration by expansion of air
- Refrigeration by throttling of gas
- Steam jet Refrigeration system
- Dry ice Refrigeration

3. ACTUAL SETUP:

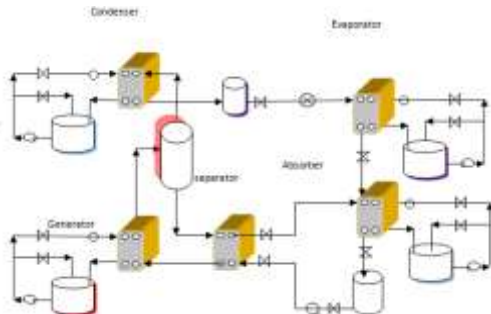


Fig.1 Simple vapor absorption refrigeration system

- In above fig.1 show the block diagram of the VARS in that five brazed plate heat exchangers are used as a condenser, absorber, evaporator, generator etc.
- The separator is used to separate the vapour and liquid. Performance of absorption refrigeration systems is critically dependent on the chemical and thermodynamic properties of the working fluid. A fundamental requirement of absorbent/refrigerant combination is that, in liquid phase, they must have a margin of miscibility within the operating temperature range of the cycle. The Mixture should also be chemically stable, non-toxic, and non-explosive. In addition to these requirements, the following are desirable.
- The elevation of boiling (the difference in boiling point between the pure refrigerant and the mixture at the same pressure) should be as large as possible.
- Refrigerant should have high heat of vaporization and high concentration within the absorbent in order to maintain low circulation rate between the generator and the absorber per unit of cooling capacity.
- Transport properties that influence heat and mass transfer, e.g., viscosity, thermal conductivity, and diffusion coefficient should be favorable.
- Both refrigerant and absorbent should be non-corrosive, environmental friendly, and low-cost.

3.1 The actual overall process flow as below:

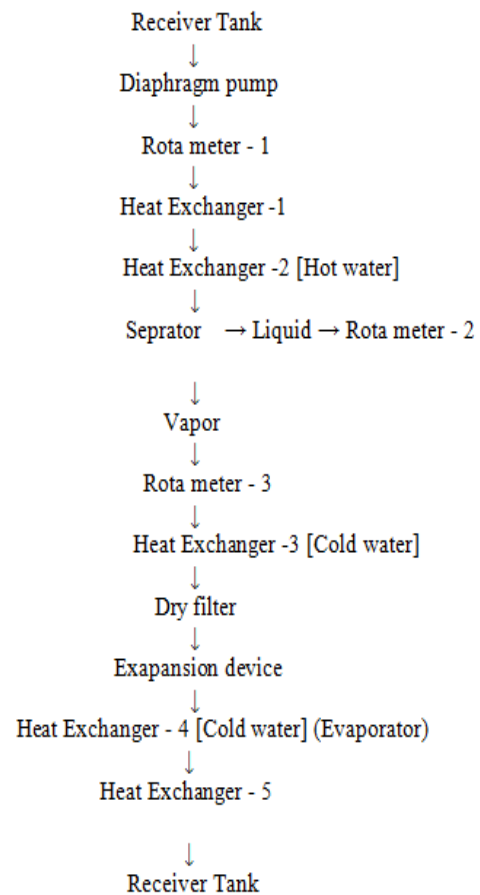


Fig.2 Process flow chart

The whole process is cyclic process. In that the starting from the receiver tank and the end with that tank. Totally five heat exchanger and three rota meter used to complete the process.

3.2 Hydraulic Diaphragm Type Dosing Pump specification:

Sr.No	Name	Qty.
1	Liquid	Mixture R134a and dimethyl Formamide
2	PUMP type	Hydraulic Diaphragm Pump
3	Pump Model	VHYD-02
4	Pump Performance	As per API 675 Standard
5	Pressure Kg/cm2 (Testing)	10-12
6	Pressure Kg/cm2 (Suction)	Flooded
7	Pressure Kg/cm2 (Hydro)	15
8	Capacity in LPH (Required)	0-100
9	Pressure Relief Valve	Inbuilt
10	Gear Ratio	15:1
11	Plunger Dia.(In MM)	36
12	Drive Capacity	0.5 HP
13	Coupling type	Flexible Spider

Table No.1

3.3 Brazed plate heat exchanger:

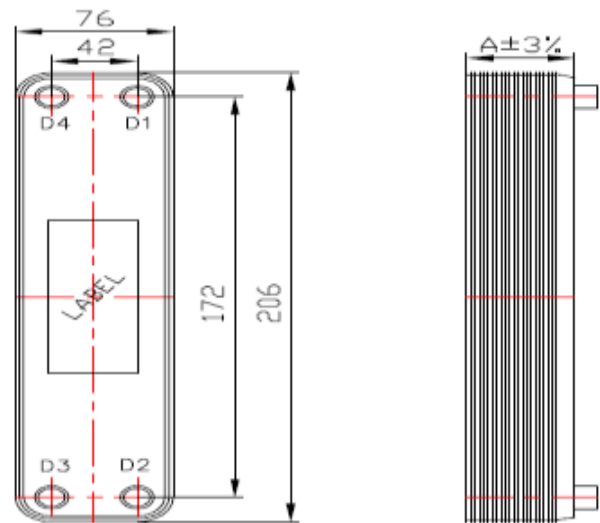


Fig.3 Brazed plate heat exchanger

A plate heat exchanger is a sort of warmth exchanger that utilizes metal plates to exchange heat between two liquids. This has a noteworthy favourable position over a customary warmth exchanger in that the liquids are presented to an a lot bigger surface zone in light of the fact that the liquids are spread out over the plates. This encourages the exchange of warmth, and enormously builds the speed of the temperature change. Plate heat exchangers are currently normal and little brazed variants are utilized in the high temp water areas of a huge number of blend boilers. The high warmth exchange proficiency for such a little physical size has expanded the household heated water (DHW) flow rate of mix boilers. The little plate heat exchanger has had an incredible effect in local warming and high temp water. Bigger business adaptations use gaskets between the plates, though littler variants will in general be brazed.

4. RESULT AND DISCUSSION:

In that system we focus on the mixing of the two refrigerants, in which one is liquid (DMF) and other is vapour(R-134a).

The purpose of the mixing of two refrigerants is to increase the overall COP and reuse the cycle. The whole process first carried out on

the CFD ANSYS software, after those results we carry forward the process.

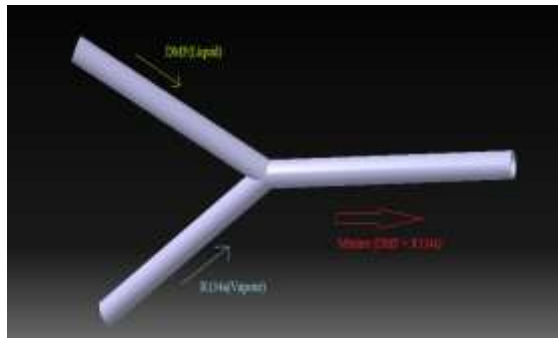


Fig.4 Mixing of two refrigerants

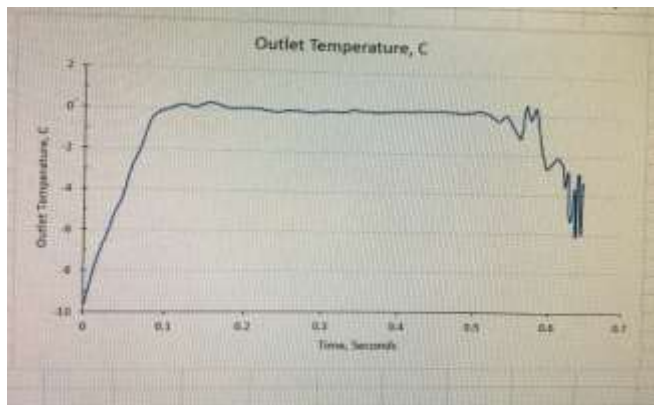


Fig.5 Graph 1

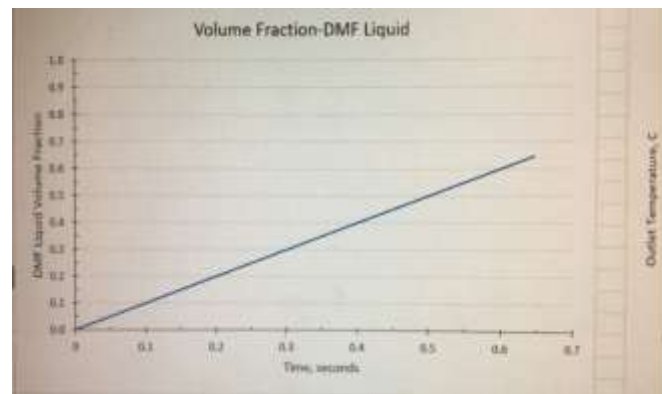


Fig.6 Graph 2

with in a limited range of system design parameters. The literature on small vapour absorption systems is scant and very few studies have been done on smaller systems. Best mixture of the two refrigerants gives the maximum COP and optimum solution on today's problems.

REFERENCES

- [1] Hiwen, Shu., Lin, Duanmu., Xiangli, Li., Yingxin, Zhu., Energy-saving judgment of electric- driven sea water source heat pump district heating system over boiler house district heating system, *Energy and buildings*, Vol. 42, (2010), pp. (889-895).
- [2] Y. J. Kim, S. Kim, Y. K. Joshi, A. G. Fedorovc, and P. A. Kohl, "Thermodynamic analysis of an absorption refrigeration system with ionic liquid/refrigerant mixture as a working fluid," *Energy*, vol. 44, no. 1, pp. 1005-1016, 2012.
- [3] Yokozeki, A, 2005. Theoretical performances of various refrigerant-absorbent pairs in a vapor-absorption refrigeration cycle by the use of equations of state. *Applied Energy*, Vol 80(4), pp 383 - 399.
- [4] M.B Arun, M.P Maiya, S.Srinivasa Murthy: Performance comparison of double effect parallel flow and series flow LiBr and H2O absorption systems, *applied thermal engineering*(2001)1273-1279.
- [5] Herold KE, Radermacher L. Absorption heat pump, *Mech. Eng.*, Aug, 1989;68-73.

5. CONCLUSION

The above studies are simulation studies. Regarding compression-absorption systems studies have been carried out by many researchers mostly analytically and experimentally.

In vapour absorption cycles, it is found that mostly the studies are carried out on large capacity systems and the investigation had been carried out