Manufacturing of Magnetic Refrigeration System

A.A Darade *, U.V.Desale*, A.B.Jadhav* N.K. Madhave* M.R.Ramteke*

#Department of Mechanical Engineering, Savitribai Phule Pune University
1amoldarade07@gmail.com, 2utkarshdesale1998@gmail.com
3amitbjadhav1998@gmail.com, 4nikhil.s.madhave@gmail.com,
5mrramteke_skncoe@sinhgad.edu

Abstract

Refrigerator is a device used for chilling of food products for the both commercial and domestic appliances utilizing mechanical vapor compression Cycle in its process. Optimization for the better performance of the system becomes main issue and many researches are still ongoing to improve efficiency of the system. The main objective of this work is to enhance the performance of the domestic refrigerator by flooding the evaporator with liquid refrigerant. This work presents a Vapor compression refrigeration (VCR) system for simultaneous cooling utilities for different purpose in industries, hotels. The main advantage of the simultaneous is to carry out cooling by which fossil fuel can be saved by minimize the use of the energy due to simultaneous operation. And even due to simultaneous operation the requirement of individual equipment is no more so it saved the first cost of equipment. For project work magnetic arrangement before expansion device so increase COP and efficiency of VCR System also evaporator is used in which water flow rate is varied and test was conducted.

Keywords—*Magnetic refrigeration,Coefficient of performance.*

1.Introduction

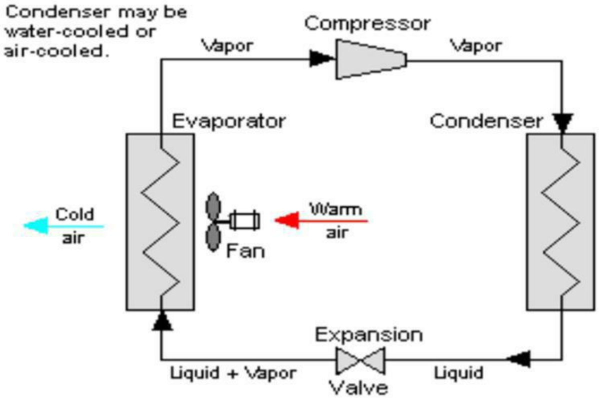
Nowadays classical vapour compression refrigeration technology is widely used, but there are various limitations in using vapour compression system, because technology is very energy inefficient. This project of Magnetic vapour compression system is for performance enhancement of VCR system to increase COP and efficiency by using magnetocalorific effect also producing low cost , stable , ecofriendly VCR system .

2. Objectives

Evaporating heat transfer is very important in the refrigeration and air-conditioning systems. HFC 134a is the mostly widely used alternative refrigerant in refrigeration equipment such as domestic refrigerators and air conditioners. Though the global warming up potential of HFC134a is relatively high, it is affirmed that it is a long term alternative refrigerants in lots of countries.

The objectives of these stages are also discussed below.

1. Building up of a test rig for evaluating a performance of domestic VCC.
2. To perform experimental performance by using square magnet arrangement around the capillary tube.
3. To perform experimental performance for heating and cooling effect.



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(a)

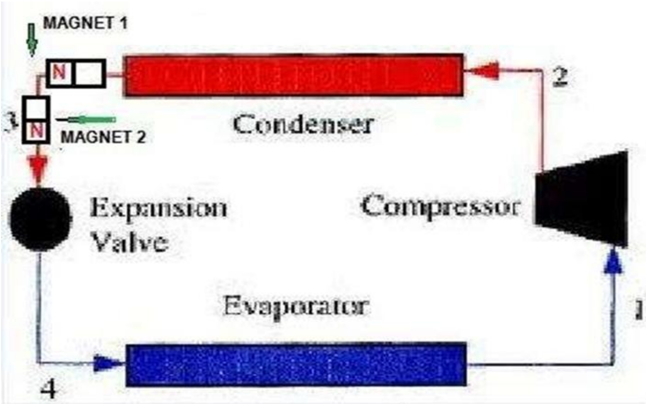

Fig. 1 Representation of magnetic refrigeration system (a) VCR System and (b) Magnetic refrigeration System

3.General theory about magnetic field

as well as less liquid refrigerant was boiling in the compressor shell. compression refrigeration system. It was shown that propane and propane/isobutene mixtures conducted included the relationship between the nature of magnetic transformation and the effect and its application regarding the cooling near room temperature. The study the research on magnetic calorific intermolecular forces in the working fluid and enhance expansion of the -working fluid magnetic field force, increases compressor head pressure and discharge temperature slightly magneto-caloric. may be used in an unmodified R12 system and give better coefficients of performance (COP) molecules. power consumption of the compressor and improving the performance of the system. The refrigerants such as R410A, R507, R407C, and R404A under various conditions of magnetic results also reported that the increase in the magnetic field force enhances the COP of the Richardson et al have investigated the performance of HC 290/HC 600a mixture in a vapour system. The test results of the performance of new alternative temperature dependence of the magnetic calorific effect and the entropy utilized in the

than R12 under the same operating conditions. The magnetic field was applied to the working field in the liquid phase to disrupt the performance of new alternative refrigerants such as R410A, R507, R407C, and R404A This reduces the amount of residual liquid that is boiled in the compressor shell, lowering the under various conditions of magnetic field. The test results reported that the increase in field.

5.Compressor

The low pressure and temperature vapour refrigerant from evaporator is drawn into the compressor through the inlet or suction valve A, where it is compressed to a high pressure and temperature. This high pressure and temperature vapour refrigerant is discharged into the condenser through the delivery or discharge valve classes:

4. Condenser

The condenser or cooler consists of coils of pipe in which the high pressure and temperature vapour refrigerant is cooled and condensed. Refrigeration System The refrigerant, while passing through the condenser, gives up its latent heat to the surrounding condensing medium which is normally air or water.

6. Receiver

The condensed liquid refrigerant from the condenser is stored in a vessel known as receiver from where it is supplied to the evaporator through the expansion valve or refrigerant control valve.

7.Square Type Magnet arrangement:

Before the expansion device square type magnet arrangement done then the attraction between permanent magnet the capillary tube pressure and temperature drop the gas is transfer to a expansion device.

8.Expansion Valve

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It is also called throttle valve or refrigerant control valve. The function of the expansion valve is to allow the liquid refrigerant under high pressure and temperature to pass at a controlled rate after reducing its pressure and temperature. Some of the liquid refrigerant evaporates as it passes through the expansion valve, but the greater portion is vaporized in the evaporator at the low pressure and temperature.

9.Evaporator

An evaporator consists of coils of pipe in which the liquid-vapour. Refrigerant at low pressure and temperature is evaporated and changed into vapour refrigerant at low pressure and temperature. In evaporating, the liquid vapour refrigerant absorbs its latent heat of vaporization from the medium (air, water or brine) which is to be cooled..

10.Calculation of condenser:

The condenser load can be calculated by the following equation:
Heat transfer Q=m Cpl (T3-T2)
Load on the condenser = m Cpl (T3-T4)
Q = heat absorbed in evaporator + heat of compressor.
Heat absorbed in evaporator = 1555 k cal/h
Heat of compressor = v x 1
= 220 x 3 =640w
= 640 x 0.86 =550.4 kcal. Q = 1555 + 550.4
= 2105.4 k cal
= 2105.4/ 400 x 22
= 0.239
A = Πdl
d = 5mm
Length of coil (L) = 0.239 / 0.005= 15.23m
LENGTH IN ONE TURN = (40 + 40) = 80cm
Number of turns required = 15.23 / 0.80

= 19.0389
= 20
Evaporator Temperature (T1) = -30ºC
Condenser Temperature ($T2^1$) = 30ºC From charts, At -30ºC, Enthalpy (h1) = 338.143 kJ/kg Entropy (s1) = 1.57507 kJ/ (kg.K)
At 30ºC, Enthalpy ($h2^1$) = 363.566 kJ/kg
Entropy ($s2^1$) = 1.54334 kJ/ (kg.K)
Enthalpy (h3) = 228.540 kJ/kg From the graph,
s1 = s2 and h3 = h4 We know that,
$h2 = h2^1 + Cp(T2 – T2^1)$
Equation – A
$s2 = s2^1 + Cp\ln (T2/T2^1)$
1.57507 = 1.54334 + 0.7253 * ln (T2/303)
On simplification we get, T2 = 316.5 K
Substituting in Equation – A we have,
h2 = 363.566 + 0.7253 * (316.5 – 303)
= 373.35 kJ/kg
1).Refrigerating Effect = h1 – h4
= 109.603 kJ/kg
(2)Coefficient of Performance (C.O.P) =Refrigerating Effect / Work done by the Compressor= (h1 – h4)/ (h2 – h1)
=3.11

11. Drier

Filter-driers play a pivotal role in the operation of air conditioning and refrigeration systems. At the heart of the unit is the desiccant held in its cylindrical metal container. As important as the filter-drier is, many actually do not understand how it works. Here are some details. The word desiccate means to dry out completely and a desiccant is a material or substance that accomplishes the moisture removal.

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Moisture in the mechanical refrigeration cycle is detrimental to the operation and life of the system. The filter-drier is an accessory that performs the functions of filtering out particles and removing and holding moisture to prevent it from circulating through the system.

12. Refrigerants

A refrigerant is the medium of heat transfer, which absorbs heat by evaporating at low temperatures and give out heat by condensing at high temperature and pressure conditions. A refrigerant must meet certain chemical, physical and thermodynamic properties so that it can be used suitably in the Vapour compression cycle. A good refrigerant should have safe working properties apart from having economic aspectsthere are wide differences in conditions and requirements of various applications hence single refrigerant is not universally suitable. The working fluid used to transfer the heat from low temperature reservoir to high temperature reservoir is called refrigerant. Refrigerant classified in two type Primary and Secondary refrigerant. Primary refrigerants are those which can be directly used for the purpose of refrigeration. If the refrigerant is allowed to flow freely into the space to be refrigerated and there is no danger of possible harm to human beings, then primary refrigerants are used. There are different types of refrigerant which are described as followings. CFC: They are molecules composed of carbon, chlorine and fluorine. They are stable, allowing them to reach the stratosphere without too many problems. It contributes to the destruction of the ozone layer. These are R11, R12, R113, R500, R502 etc. HCFC: They are molecules composed of carbon, chlorine, fluorine and hydrogen. They are less stable than CFCs, destroy ozone and to a lesser extent. These are R22, R123, R124, R401a etc. HFC. They are molecules composed of carbon, fluorine and hydrogen. They do not contain chlorine and therefore do not participate in the destruction of the ozone layer. This is known as substitution substance. Restrictions on this family of gas are currently limited. Within the European Union, the HFC will be banned from air conditioners for cars from 2011.These are R134a. In the process of searching for new alternative, since no single component refrigerant matches, hence refrigerant blends as alternative was recommended, because by mixing two or more refrigerants a new working fluid with the desired characteristic can be developed. Problem with blend of refrigerants is that not all of the properties can match the original refrigerant under all conditions. R12 for example will rarely match the pressure at all point in the desired temperature range. What is more common is that the blend will match in one region and the pressure differs elsewhere. The mixture of refrigerants could be A zeotrope, in which two or more refrigerants with similar boiling point acts as a single fluid. The components of the mixture will not separate under normal operating conditions and can be charged as a vapour or liquid. An example of these blends is 50/50, which is the mixture of R32 and R134a. The near Azeotrope mixture consist of two or more refrigerants with different boiling points, when in liquid or vapour state, act as one component. When changing from vapour to liquid or liquid to vapour, individual refrigerant evaporates or condenses at different temperatures. The mixture has a temperature glide of less than 10 and should be charged in the liquid state to assume proper mixture, and the Zeotrope which is a mixture made up of two or more refrigerants with different boiling points, they are charged in the liquid state.

13. EXPANSION VALVE

An expansion device in refrigeration system normally serves two purposes. The purpose of an expansion valve is

a) To reduce the pressure from the condenser pressure to the evaporator pressure and

b) To control the mass flow rate in the refrigeration system according to some predetermined criterion.

The mass flow rate in the system should under ideal conditions to be proportional to the cooling load on plant. Sometimes the product to be cooled is such that a constant evaporator temperature has to be maintained. In other cases, it is desirable that the liquid refrigerant should not enter the compressor. In such cases, the mass flow rate has to be controlled in such manner that only the superheated vapour leaves the evaporator. Again, an ideal refrigeration system should have the facility to control the mass flow rate in such way that the energy requirement is minimum and the both the required criterion of temperature and cooling load are satisfied. Some additional controls to control the capacity of the compressor and the space temperature may require as well, so as minimizing energy consumption. There are two basic types of control on the compressor, namely on-off control and the proportional control. The expansion valve used in refrigeration systems has to be compatible with the overall system.

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14.CONCLUSION

This experiment shows that on the application of magnetic field the COP increases drastically using hydrocarbon as a refrigerant. Thus study is to validate that there is improvement in the COP of the vapour compression cycle by placing permanent magnets at the exit of condenser. The is carried to validate that there is change of 17.89% of COP than the conventional vapour compression cycle. Improvement in COP = (COP with application of magnetic field/ COP without application of magnetic field) * 100. 18% COP improvement is experimentally observed with application of the magnetic field on R404a.

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[5] Department of Physics, Kookmin University, Seoul Magnetic Refrigeration Properties of La, CaMAGNETIC refrigeration based on magneto caloric effect(MCE) has been proved as a promising alternative to conventional gas refrigeration.

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