REFRIGERATION SYSTEM WITH SUBCOOLING USING ALTERNATE REFRIGERANT

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ABSTRACT: In this generation we are using the refrigeration system with R134a as a refrigerant. There are some drawbacks like global warming and environmental pollution. This will also causes ozone depletion in our ozone layer. So we are going to change the refrigerant as alternate for refrigerant R134a. So we are trying to use R404a as a alternative refrigerant. And also we are applied the sub cooling concept for the refrigeration system for improving the performance.

I . INTRODUCTION

The term "*refrigeration*" may be defined as the process of removing heat from a substance under controlled conditions. It also includes the process of reducing and maintaining the temperature of a body below the general temperature of its surroundings. In other words, the refrigeration means a continued extraction of heat from a body whose temperature is already below temperature of its surroundings. In a refrigerator, heat is virtually pumped from a lower temperature to a higher temperature. According to Second Law of Thermodynamics, a well-known ***Clausius statement*** asserts: ***It is impossible to construct a device that, operating in a cycle, has no effect other than the transfer of heat from a cooler to a hotter body.***

Thus the Clausius statement tells us that energy (heat) will not flow from cold to hot regions without outside assistance. It is thus obvious that supply of power is regularly required to drive a refrigerator. Theoretically, a refrigerator is a reversed heat engine or a heat pump which pumps heat from a cold body and delivers it to a hot body. The substance which works in a pump to extract heat from a cold body and to deliver it to a hot body is known as refrigerant.

The following systems are the types of refrigeration

1. The *vapor compression* refrigeration system is the mainstay of the refrigeration and air conditioning industry.
2. *Absorption* refrigeration provides an alternative to the vapor compression approach, particularly in applications where a heat source is economical and readily available.\

II.BASICS COMPONENTS OF REFRIGERATION

A.COMPRESSOR

A machine used to supply air or other gas at increased pressure shown in fig.1. While most small and medium capacity refrigeration systems uses hermetically sealed, electric motor-driven compressor units or open (externally powered) reciprocating compressors, centrifugal compressors are frequently found in large units for cooling buildings and for industrial applications.

Fig.1. Compressor

B.CONDENSER

A condenser is a device or unit used to condense a substance from its gaseous to its liquid state, by cooling it. The condenser coil itself has a snake-like shape, with a complex set of internal tubing used to manage the process of transferring heat or cooled air as shown in fig.2.

Fig.2.Condenser

C.*THROTTLING DEVICE*

The *throttling device*, restrains the flow of refrigerant from the condenser to the evaporator. Its primary purpose is to provide the flow resistance necessary to maintain the pressure difference between the two heat exchangers. It also serves to control the rate of flow from condenser to evaporator.

The throttling device may be a *thermostatic expansion valve* (TEV) controlled by evaporator exit temperature or a long, fine-bore pipe called a *capillary tube* as shown in fig.3.

Fig.3.Capillary tube

D.DRIER/STRAINER

The Strainer/Drier is attached to the one end of capillary tube from the condenser line is prevented. It contains silica gel which is used to absorb the air molecules present in the liquid refrigerant. So that the formation of ice inside the copper tube as shown in fig.4.

Fig.4.Drier

E.EVAPORATOR

The process of heat removal from the substance to be cooled or refrigerated is done in the evaporator. The liquid refrigerant is vaporized inside the evaporator (coil or shell) in order to remove heat from a fluid such as air, water etc. Evaporators are manufactured in different shapes, types and designs to suit adverse nature of cooling requirements. Thus, we have a variety of types of evaporators, such as prime surface types, finned tube or extended surface type, shell and tube liquid chillers, etc.

F.REFRIGERANT

R404a is a blend of HFC refrigerants commonly used for medium and low temperature refrigeration applications. It's composition comprises: HFC-125 (44%), HFC-143a (52%), HFC-134a (4%).In order to reduce the pollution, we are using R404a instead of R134a as refrigerant. The property of R404a was shown in table.1.

PROPERTIES	R32	R125	R134a	R404a
Boiling point(1atm,F)	-33	-48.3	-14.9	-43.6
Critical pressure(psi)	628	526.5	588.3	672.1
Critical temperature(F)	173	252.5	213.8	187
Heat of vapourization (bp,BTU/lb.F)	101	70.6	93.3	106.7
Specific heat liquid(70F,BTU/lb.F)	431	265	3366	3597
GWP	1355	599	1320	1274
ODP	0	0	0	0

Table.1. Properties of R404a

III.WORKING PROCEDURE

The objective of the study is to compare the refrigeration performance of different refrigerants in terms of COP. RTD‟s were used to measure the temperatures and pressures were measured using calibrated pressure gauges.

TheRTD‟s have been located in the pockets on the surface of the tubes and sensor is calibrated to reduce experimental uncertainties. The temperatures and pressures of the refrigerant and initial water temperatures are measured at various locations in the experimental setup.

The refrigerant is charged after the system had been evacuated. The working fluids are R134a and R404a. The refrigerant R404a is zeotropic blend, which is charged in the liquid phase due to its composition shift and temperature glide.

Drop-in experiments are carried out without any modifications to the experimental apparatus. The experiment is started with R134a to set up the base reference for further comparisons with the other two refrigerants.

The Refrigerant R134a is charged into the compressor. The first stage is the compressor which increases the vapor of dry saturated state refrigerant into high pressure and high temperature. Then it enters into condenser where phase change occurs. It converts the vapour state into liquid state but the pressure and temperature remains high.

It is entered through the drier where the air molecules present in the refrigerant is absorbed by the silica gel present inside this drier. Then it passes through the capillary tube where it converts the high pressure and high temperature of liquid refrigerant into low pressure and low temperature. Finally it is allowed to enter into the evaporator.

Here it converts the liquid state refrigerant into vapor state. Cooling takes place through the evaporator and the cycle continues. Readings are taken at different junctions. Next, R404a is charged after evacuating R134a and readings are taken again.

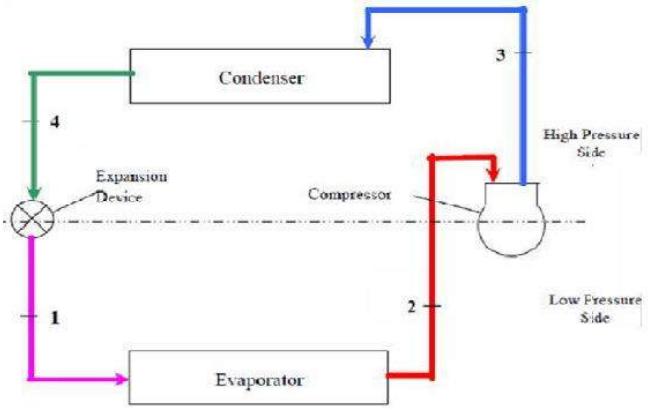

Fig.6.Working principle of refrigeration system

IV.CONCLUSION

An experimental analysis is carried out in a refrigeration system thereby the COP and Work of compression have been analyzed theoretically for different refrigerants and from the analysis it is found that R407c has the highest COP as compared to R134a.

Also R407c has the lowest work of compression as that of R134a. Though both refrigerants have few similar properties global warming potential (GWP) of R407c is lesser than R134a. Considering all these factors, R407c is superior to that of R134a.

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