Thermal Analysis of Crossed Condenser Coil Vapor Compression System

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Abstract— Day by day increasing electricity bill for consuming power for refrigeration we know that it is increasing the heat of the earth and also polluted to environment so considering of these effects to minimizing by developing of the refrigeration system with an advanced The modified dimension and functional arrangements to the refrigeration system. This refrigeration system evaporator to produces less heat releasing from advanced refrigeration systems and also we use this refrigeration system in two ways one we can use as refrigeration purpose by attaching vessel to aluminum evaporator by absorbing cooling and other way use as air conditioner. This refrigeration system was producing very less heat by connecting of special shape copper tube evaporator to the compressor and compressor connected to aluminum evaporator. This refrigeration system mainly developed by to minimizing heat produced by the evaporator from refrigeration system then global warming will be minimizing and also to minimizing electricity consuming this will help to spend money purchasing of electricity also decreasing day to day life.

Keywords: Coil Vapor Compression System

I. INTRODUCTION

Nowadays tremendously increasing usage of Refrigeration by this increasing pollution and also consumption of electricity also increasing highly and demand of electricity also increasing very height people also spending more money of purchasing electricity because comparing to the other electrical devices using in home appliances refrigerator was the major role to play continues requirement and consumption of electricity all the refrigerators usage of home appliance refrigerator condenser made with iron and exits maximum heat out to the atmosphere. Conventional refrigeration consisting in pre-cooling with seawater is a low cost refrigeration method but it needs much time and causes to produce relatively high bacterial activities. To prevent that disadvantage, pre-cooling of up to 0^0c done by a multipurpose refrigeration system is proposed. Especially clean water is plentiful, inexpensive and can be found at low temperatures should be in place institutions and condenser type can be considered as the most economical in terms of both operating costs cooling as usually only choice considering. But in recent years, high heat transmission coefficients are provided with air-cooled condensate made of rather (Refrigerant side) and inside (water side) will depend on the values of film coefficient. Whereas meat less thermal conductivity (iron pipe) when the pipes are used in condensers, heat transfer in pipe all the heat would be too late. Pollution coefficient of heat transfer surface of the water used in the water-side time to consider the impact of residues that constitute the purpose of reducing the heat transfer moves.

II. DESIGN AND FABRICATION WALK IN COOLER

A. *Specifications*

Materials	Application
Compressor	1/2 HP
Relay	for electrical
5/6' copper tube	for evaporator
Capillary tube	for expansion (10 feet) Condenser Air-cooled; for condensing the liquid
Filter drier	Dehydrator
Thermostat	Automatic defrost control
¼ tubes	Joining the tubings (4 feet) Oil for lubrication
Brazing rod	for brazing the tubings
Lead	For soldering
Wooden planks	For making the outer cabine
Wires	For electrical connections insulating the wires

B. *Tools Required*

- Soldering Iron
- Brazing Rod
- Tube Cutter
- Hammer
- Carpentry Tools
- Charging Line Gauge
- Vacuum Pump

C. *Designing of Container and assembling parts*

The sheet of 6mm gauge wooden sheet was used for making of container for refrigeration system. The sheet of 4feet ×2 feet was made use of and the development calculations are evolved. Now as the sheet is not big enough to take the center of 120 cm, hence the point was taken outside the sheet. The point was marketed making use of a string and marker pin. The angle was 90^0c after wards the height of 135 cm was marked and the undesired portion of the sheet is cut off, in a rectangular are on both ends of the sheet and attached in the shape of L as show in fig. Thus, the sheet metal of required tapering dimensions be obtained which is then soldered from the sides to get the internal container. marketed the box for placing the evaporator with dimension of 45x25x35 cm arranging with help on hack saw, hammer and pines attachments as shown in fig

Fig. 1: front view of ellipse shaped evaporator refrigerator

Fig. 2: back view of ellipse shaped evaporator refrigerator

Fig. 3: top view of ellipse shaped evaporator refrigerator

The sheet of 8mm gauge wooden sheet was used for making of container for refrigeration system. The sheet of 4feet ×2 feet was made use of and the development calculations are evolved. Now as the sheet is not big enough to take the center of 120 cm, hence the point was taken outside the sheet. The point was marketed making use of a string and marker pin. The angle was 90^0c after wards the height of 135 cm was marked and the undesired portion of the sheet is cut off, in a rectangular are on both ends of the sheet and attached in the shape of L as show in fig3.1. Thus, the sheet metal of required tapering dimensions be obtained which is then soldered from the sides to get the internal container.

D. Assembling process of crossed coil condensing cooling system

Brazing Process it is process of joining metal pieces by means of hard solder. Brass is mainly the main constituent of this solder. The brazing solder used in modern practice is commercially known as smelter, which is mixture of Cu, Zn and Sn. The most important phenomenon in this that the pieces to be joined are heated instead of the tube. Winding of Cu Tubes Once the internal container is repaired, it is soldered at its ends. Now 5/6" copper tubes of length one feet was wound around the outer surface of the sheet metal internal container, with equal spacing between them. These "Cu" tubes were positioned in their place firmly and rigidly with the help of soldering at place. Now these assembly functions as our Evaporator and these coils are called as Evaporator Coils. Both the ends of the Cu tubes Viz, the top and bottom of the internal container, where left free or unwound the upper portion of the tube was taken below along the external surface of the container and finally taken out of the bottom of the plastic bucket through a small boring. The other end of the coil was connected to the accumulator which is placed in between the bottoms of the bucket and the container. Ten this end was also taken out of the same boring and connected to the capillary tubes.

E. Capillary Connection

One end of the capillary was brazed inside the accumulator to prevent leakage. The total length used for the purpose was 12feet. Initially, some portion of the capillary was wound around the 5/16' tube coming out from the lop surface of the container. Then, this capillary is made in the from of a uniform coil and was suspended freely. This capillary tube acts as an expansion valve.

F. Dehydrator

The dehydrator or the filter drier is located in the fluid line at the outlet end of the condenser. Its purpose is to filter, trap minute particles of foreign materials and absorb any moisture which may be in the system. Fine mesh screens filter out foreign particles and the desiccant absorbs the moisture. The one used in this refrigerator desiccants is silica gel (silicon dioxide).

G. Condenser Connections

Now a small piece of copper tubes brazed to the free end of the filter drier, which is then connected to the condenser. The condenser used in this unit is of air cooled type. In this the tube is bent in the shape of U and placed in conjunction with the fins are responsible for holding the air in their gaps that extract heat from the hot refrigerant flowing in the tubes of the condenser.

H. Evaporator

The evaporator coils bend and form a shap of rectangle and connected to the compressor to the one and surrounding the internal container absorb the heat from the hot boy inside the container and this heat is taken by the refrigerant. This refrigerant which is ultimate passing through the condenser radiates heat to the atmosphere with help of the condenser fins.

In our unit the condenser is fixed to the rear side of the cabinet, facing the atmosphere air.

I. Compressor Connection

The 5/6' copper tube of the evaporator oil is connected to one end the compressor with the help of brazing. The outgoing end of the compressor is brazed to the condenser to complete the circuit.

The compressor used in this case is reciprocating type sealed unit. The horsepower of the compressor is 1/6 HP. Compressor is used to establish a pressure difference and thus cause the refrigerant to flow from one part of the system to the other. At the same time the compressor raises the refrigerants pressure above the condensing pint.

At the temperature of the room air, so it will condense. It is this difference in pressure between the high low sides forces liquid refrigerant through the capillary tube an into the evaporator.

J. Thermostat

This is a temperature controlled electrical switch located on the evaporator wall. It is fastened to the evaporator will with a clamp at the lower region of the internal container. When the sensing element mounted on the evaporator wall senses the temperature lower than the operating conditions then it sends the signal to the thermostat switch immediately breaks the circuit in the relay and thus gets Tripped Off. The thermostat switch is connected to the relay. The rely thermostat has the bimetal strips, which is responsible for the make and break of the circuit.

III. Gas Charging

When the whole of the connections has been made then gas is charged with the help of the charging cylinder and the value is closed. The whole is now checked for the leakage by applying soap solution to the joints formed by brazing. Now when no leakage was there then the gas was filled. The amount of gas by weight was 15 ibs. The gas used for this was refrigerant R134A.

A. Mathematical analysis

Observations of normal evaporator Ambient Temperature = 28^0c
Refrigerant R134a
Evaporator Temperature = – 1.8^0c Condenser temperature = 37^0c Compressor suction pressure 17psi Discharge pressure 135psi Operating power 287watts

1) From PT chart for R134a,

Pressure at 28^0c = 91.3 psi lpc cut-in Pressure = 57 psi
Differential (Diff.) = 15 psig
LPC cut-out Pressure = LPC CUT-IN Pressure – Differential
LPC cut-out Pressure =57 – 15 LPC cut-out Pressure = 42 psig From P/T Chart for R413a,
lpc cut-out Temperature at 42 psig = 8^0c
2. Observations of circuit based evaporator Ambient Temperature = 28^0c Refrigerant R413a
Evaporator Temperature = – 1.8^0c Condenser temperature = 37^0c Compressor suction pressure 17psi Discharge pressure 135psi
Operating power 309watts Evaporator temperature 5^0c

B. Calculate total electrical load of praposedvapor compression system:

1) COMPRESSOR

HP: 1 HP
Rated Load Amperage (RLA): 0.26 Amps Voltage: 230 Volts
Input Volt Ampère (VA) = Voltage x RLA
Input Volt Ampère (VA) = 230 Volts x 0.26 Amps
=59.8watts=60watts

2) COOLING FAN

Electrical Data for Evaporator Model KLP104MA-S1B: HP: 1/15 HP
Watts: 100 watts PSC Motor x 1 Voltage: 230 Volts
MCA: 1.3 Amps
Max. Fuse: 15 Amps
Max. Overcurrent Protection (MOP): 15 Amps Full Load Amps (FLA): 1 Amp
Motor Efficiency: 100 watts/230 watts = 43% Input Volt Ampere (VA) = 40 Volts x 1 Amp Input Volt Ampere (VA) = 40 watts
Controls Load - Thermostat
From PENN/Johnson Controls A419 Thermostat specifications,
Voltage: 120 Volts
Light load Inside the container 8watts
Control load of Electric al accessories 30Watts TOTAL CONSUMING POWER: 60+40+1.8+8+30==139.8 watts

IV. Result and Analysis

1) The above result shows the walk in cooler is consuming less amount electricity comparing the existed air cooling system
   In market least electricity consuming air condition consumes 800 watts
   And market least electricity consuming refrigeration consumes 150 watts
   But this two way using system consuming 139.8 watts
   So the difference was 813 watts
   By this result our walk in cooler was less electricity consuming system
2) so this system can use middle class families and upper class families and also commercial purpose can use low maintenance cost and also it can take very less space so small houses also it can keep
3) Arrangement of this system also takes easily less skilled persons also arranged easily without any heavy effort
4) Increasing of compressor power it can use commercial building and it can replace easily in less space anywhere.

V. Conclusion

In this article to prove modified refrigeration consume energy savings in home vapor compression systems. Explicit relationships of the heating, ventilation air conditioning process characteristics with respect to the controlled and uncontrolled variables under operating conditions are established by using experimentally- collected data and empirically-based regression. The power consumption of the two way using air vapor compression system can then be expressed as a function of these variables in a proposed quadratic equation to facilitate the derivation of maximum energy saving conditions. A case study of a usage of power for vapor compression systems for middle class families in hot and dry summer time shows the effectiveness of the proposed method.

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