Performance analysis and fabrication of Refrigerator using Deep-cooling condenser to increase COP of Refrigeration

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ABSTRACT

Our final year project, i.e. Performance analysis and fabrication of Refrigerator using Deep-cooling condenser to increase COP of Refrigeration, aims at increasing the COP of refrigeration, The basis of modern refrigeration is the ability of liquid to absorb Enormous quantities of heat as they boil and evaporate. Our Project based on Simple refrigeration system which uses the vapour compression cycle. The vapour compression Cycle comprises four process compression, condensing, expansion and evaporation process.

Our modified refrigerator contains various parts such as- Compressor, Condenser, Deep Cooling Condenser, Expansion valve, Evaporator coil chilling tank and various measuring equipment's like digital temperature Indicator, pressure gauges. A refrigerant is a compound used in a heat cycle that undergoes a Phase change from a gas to a liquid and back. We are using R-10 as a primary refrigerant as it is a user friendly refrigerant and ethylene glycol a secondary refrigerant. Our aim is to save the power required for refrigeration by using R-134a as primary refrigerant..

Keyword: - *Vapour Compression Refrigeration System, COP. Deep Cooling Condenser*

1. INTRODUCTION

Our project is based on the principle of simple refrigeration system which use the vapour compression cycle. The vapour compression cycle comprises four process compression, condensing, expansion, and evaporation process. In modified refrigerator the vapour compression cycle comprises five process compression, deep condensing, condensing, expansion and evaporation process. In this setup high temperature come from compressor are use to heat the food in deep cooling condenser at normal temperature.

This extra condenser act as a heat exchanger, which save the energy like cooking gas or it is also work like oven.

A. Co-efficient of performance (COP)

The co-efficient of performance which is defined as the ratio of heat absorbed by the refrigerant while passing through the evaporator to the work input; in short it is the ratio between heat extracted and work done.

COP = Rn/W

Rn = heat absorbed

W = workdone

B. Ton of refrigeration(TR).

A ton of refrigeration is the American unit of refrigerating effect (R.E).It is the rate at which heat is required to be remove to freeze one ton of water at 0 ^{0}C.

1 tonne of refrigeration = 14000 kj/h (1 ton = 0.9 tonne)

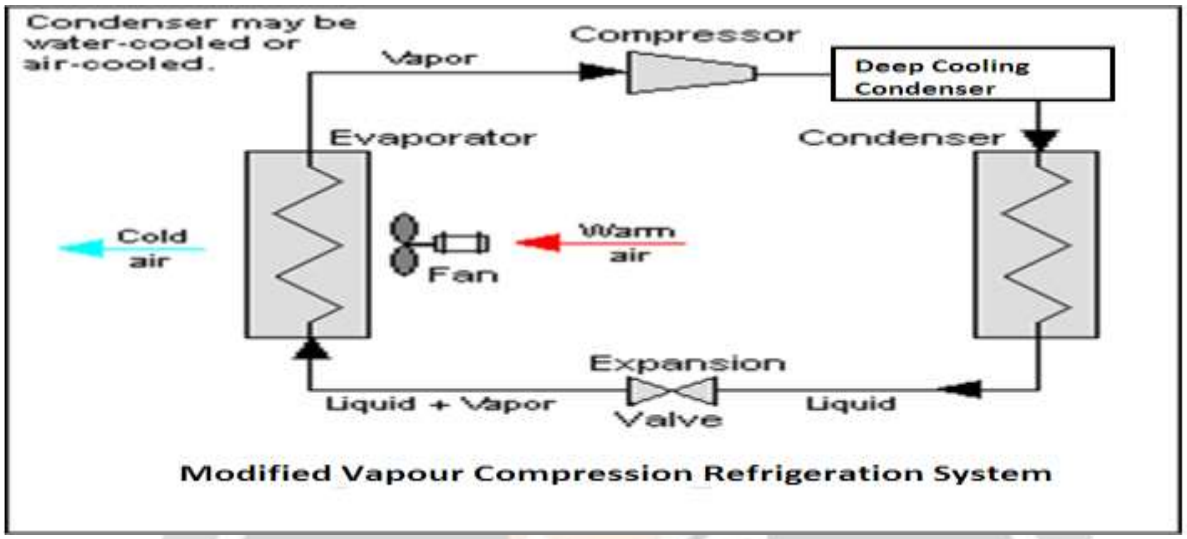


Fig -1: Modified VCRS

2.DESIGN PARAMETERS

The modified VCRS system cycle is shown in that schematic diagram. There is refrigerant flow is shown as compressor, deep cooling condenser, condenser, expansion device, evaporator and again compressor.

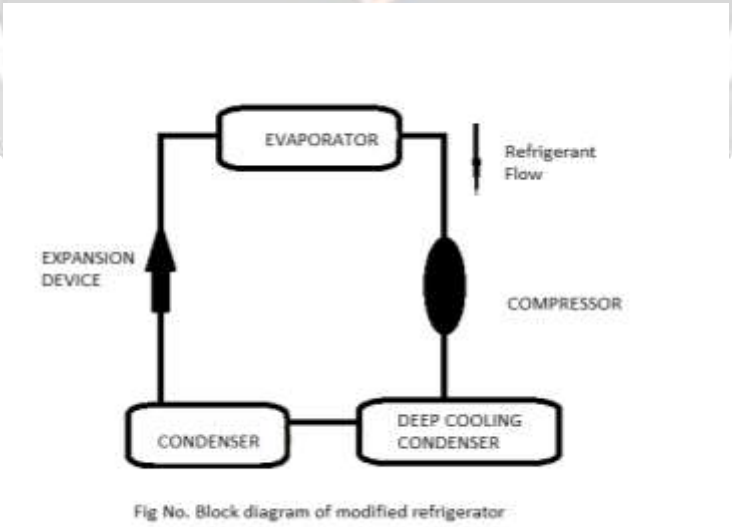


Fig -2: Block Diagram Of Modified Refrigerator

2.1 DESIGN SPECIFICATION

COMPRESSOR : Hermetically sealed type of LBP

Make = LGMA62LBJG

Horse power = 1/5 HP

Cooling capacity = 59613 TU/11

Power watt = 134 W

CONDENSER : Fin type air cooled condenser

Pipe diameter = 3.8 cm

Pipe length = 20 ft

Condenser size = 10H*12L*4W

DEEP COOLING CONDENSER: Condenser size = 20×10

DISCHARGE LINE HP : Discharge pipe size = ¼ inch

Discharge pipe length = 21cm

LIQUID LINE : Liquid line size = ¼ inch

Liquid pipe length = 21 cm

LIQUID RECEIVER TYPE : Type of receiver = accumulation type

Receiver length = 6 inch

Receiver width = 2 inch

STRAINER : Copper silica gel strainer size = ¼inch

EXPANSION DEVICE : Capillary type8237817200

Length of capillary expansion= 12ft

SUCTION LINE LP : Suction line size = 5/16 inch

Suction line length = 2ft

COOLING COIL : pipe type cooling coil

Pipe size = 3/ inch

Length of size = 9ft

FAN MOTOR : HP of fan motor = 1/35 HP

Type of fan motor = single pole motor

HIGH PRESSURE GAUGE : 0 PSI = 500 PSI

LOW PRESSURE GAUGE : - 30 PSI Mercury = 150 PSI

TEMPERATURE CONTROL : auto cut thermostat type temperature

PUMP SPECIFICATION : RS-702

AC-230 volts, 50Hz. 18 watts

Q_{max} = 1500 L/H

H_{max} = 0.8 m

3. ANALYSIS

3.1With deep cooling condenser

After the market survey and collecting the all required component for project fabrication process is start. In the project after the designing of project layout arrange the all component in proper sequence. The all required equipment and tools are collected. First release the refrigerant from the compressor. Then the VCRS circuit is break by the help of metal cutter. The outlet of compressor is joint to the deep cooling condenser. In deep cooling condenser the 20×10 inch box is making by using thin steel sheet and joint it by the help of gas welding. After the weld of steel sheet box the thermocol is placed surround the steel sheet box as an insulator. This insulating material (thermocol) is packed by the other thin steel sheet and all side where the insulating material is placed and joints it by gas welding. The outlet of compressor is joint to the deep cooling condenser by the help of gas welding as inlet and put the deep cooling condenser on top of refrigerator body by help of industrial glue. There is door which makes to put the food inside the deep cooling condenser by help of steel sheet and joint it by door coupling and make lock on door by using steel plate and joint it on door by using nut and bolt.

Fig -3: Deep Cooling Condenser

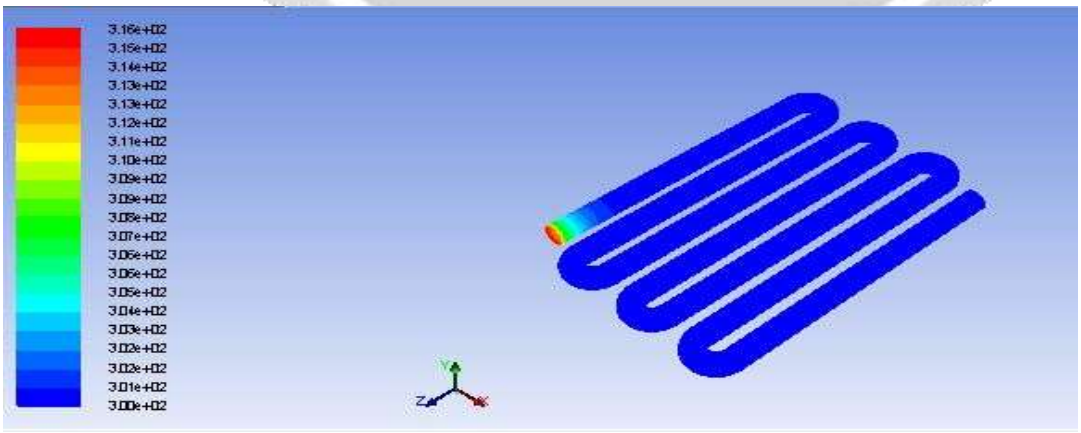
After the deep cooling condenser place on top of refrigerator body the outlet of deep cooling condenser is joint to the condenser as inlet of condenser by using 6mm copper pipe and gas welding and get the outlet of condenser. This co9ndenser outlet is joint in the expansion device (capillary tube) by help of gas welding. In the middle of condenser and expansion device the receiver is fit by help of gas welding. The expansion device outlet of copper pipe is joint in the evaporator inlet by using gas welding. Before the gas welding of copper pipe is cut in required lengthy and dimension by using metal hack saw, then joint it by the help of gas welding. The outlet of evaporator is joint by the help oh 6mm copper tube and gas welding and cut the copper pipe in required length by metal hack saw to the inlet of compressor.

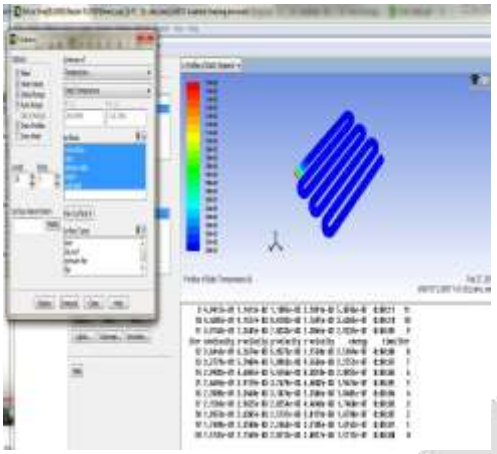
The whole component is joint in the refrigerator circuit, and then the vapour refrigerant is filling up in the compressor and starts the compressor. After starting compressor check the leakage of refrigerant gas by using the mixture of soap and water is placed on the all welded joints and check for any type of bubble occurs on the surface of soap and water mixture. There is no any type of bubbles are forms on soap and water mixture surface. The refrigerant gas is not leak from circuit means the circuit is totally ok.

Fig.4 Refrigerator With Modified Deep Cooling Condenser

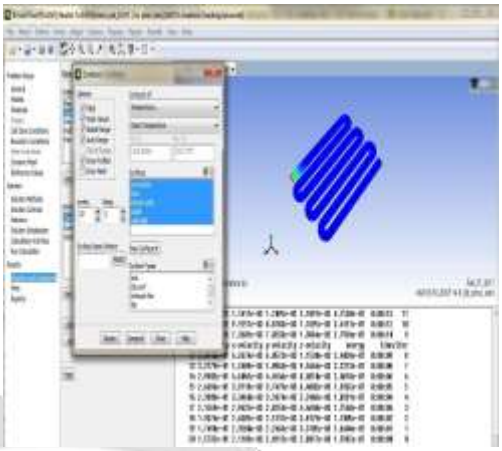
4. RESULT & DISCUSSION

4.1 RESULT BY USING ANSYS





With Deep Cooling Condenser



Without Deep Cooling Condenser

Result gives the idea of success of failure of the project which may gives satisfaction or disappointment feelings. But the reality and truth is being experienced with the help of result. The result is the key factor of the success which should be accepted in all aspects. The result of the testing is explained point wise in the following points.

1) The experiment done on the project of VCRS system.

2) After operating device by the operation have seen that the food is cook may be within 5 to 7 minutes.

3) It takes 2 to 3 hours to reach the temperature up to -15^{0}C.

4.1 DISCUSSION

While analyzing the project we discuss the following points

1) The project is easy to handle.
2) Overall construction of project is easy, less space consuming.
3) It can be used in various fields such as industries, home appliances,
4) In discussion it has been observed that our project has compact layout.

4.2 CALCULATION

	Temp ^{0}K	
1.With Deep Cooling Condenser	Max.	Min.
	315.745K	299.99K
2. Without Deep Cooling Condenser	Max.	Min.
	315.77K	304.99K
3. COP With Deep Cooling Condenser	7.25 TR	
4. COP Without Deep Cooling Condenser	6.01 TR	

Table -1:

5. CONCLUSIONS

For better performance of the refrigerator the overall C.O.P. should be increased and in environment point of view the refrigerator should be pollution free. For that many researches are going on the various constituents of the refrigerator and after research it is found out that the mostly used refrigerant having property of toxicity, erratic odor, explosive in nature and the CFC refrigerant which is compound of chlorine and fluorine chemicals.

Experimentally it is found that, chlorine react with the ozone and converted into oxygen which is the reason for ozone layer depletion. So we are going to use user friendly refrigerant.

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