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An Analysis of Rejected Heat from the Condenser of conjugal Refrigerator

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Abstract

We know in the domestic vapor compressor refrigeration system, heat is rejected from the condenser during condensation process, to the surrounding. This heat energy is wasted but it can be used for further use. This paper shows the use of this heat energy, rejected from condenser of the refrigerator by using a hot box between the compressor and condenser unit. This hot box is heated by hot refrigerant circulating around the hot box in flow pipe line. And the food in placed in the hot box is heated or warmed. In this paper we study the effect of hot box on the refrigeration unit and temperature attain in hot box for various food and material.

Keywords: Cop, Condenser, Hot Box

INTRODUCTION

Energy is the most important aspect of present scenario. Energy management is always looking towards the minimizing the wastage of energy and as we know heat is an important type of energy. In present world there are no. of equipment and machines which are producing the heat energy but their heat energy is not utilize properly or may be wasted completely like, heat rejected from the condenser of domestic vapor compressor refrigeration system. As we know, there is no. of refrigerator units that are used for cooling purpose in daily life. If we calculate total rejected by the refrigerators used in India per day, Gives a big amount of heat energy that is daily wasted in our routine life. This heat energy also causes the global warming. In this paper we are trying to use this heat energy for other domestic purpose, like heating or warming of food. The concept of hot box is initialized from this point of view. In our experiment setup we make a box that is insulated from the outside and refrigerant flow pipes, after coming from the condenser, are wound around the box between outer and inner layer of box so that heat of the refrigerant coming from compressor can concentrated in the hot box space. After passing through hot box the refrigerant is condense in the condenser.

DOMESTIC VAPOUR COMPRESSION REFRIGERATION SYSTEM

In the vapour compression refrigeration system, the phase of refrigerant changed from liquid to vapour and vapour to liquid during the cycle. Refrigerant absorb latent heat of vaporization from the refrigerated space which is at low temperature. The refrigerant which is in liquid phase enter in the evaporator coil, absorb latent heat and converted from liquid phase to vapour phase. Compressor is used to increase the pressure and temperature of vapour refrigerant so that it can be rejected this heat to the surrounding through condenser.

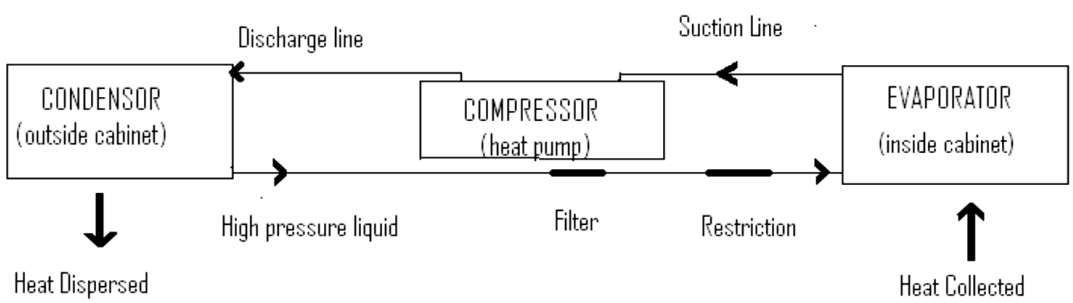


Figure 1

A mixture of vapour and liquid refrigerant enters the evaporator (refrigerator) at low pressure. The liquid refrigerant absorbs the heat in the refrigerator as its latent heat of evaporation is used to convert liquid into vapour. The function of compressor is to increase the pressure and temperature of the refrigerant so that the refrigerant vapour

would be able to dissipate its latent heat to the atmosphere through condenser. The high pressure, high temperature refrigerant vapour leaving the compressor inters into the condenser where the latent heat of vaporization of refrigerant is removed in the form of latent heat of condensation by circulating either atmospheric air or water. The liquid refrigerant leaving the condenser again enters the throttle valve and the cycle is repeated. When this high pressure and temperature refrigerant enter in the condenser, this latent heat is removed by atmospheric air or by water and converts again in liquid phase. This liquid refrigerant again enters the throttle valve and this cycle is repeated again and again.

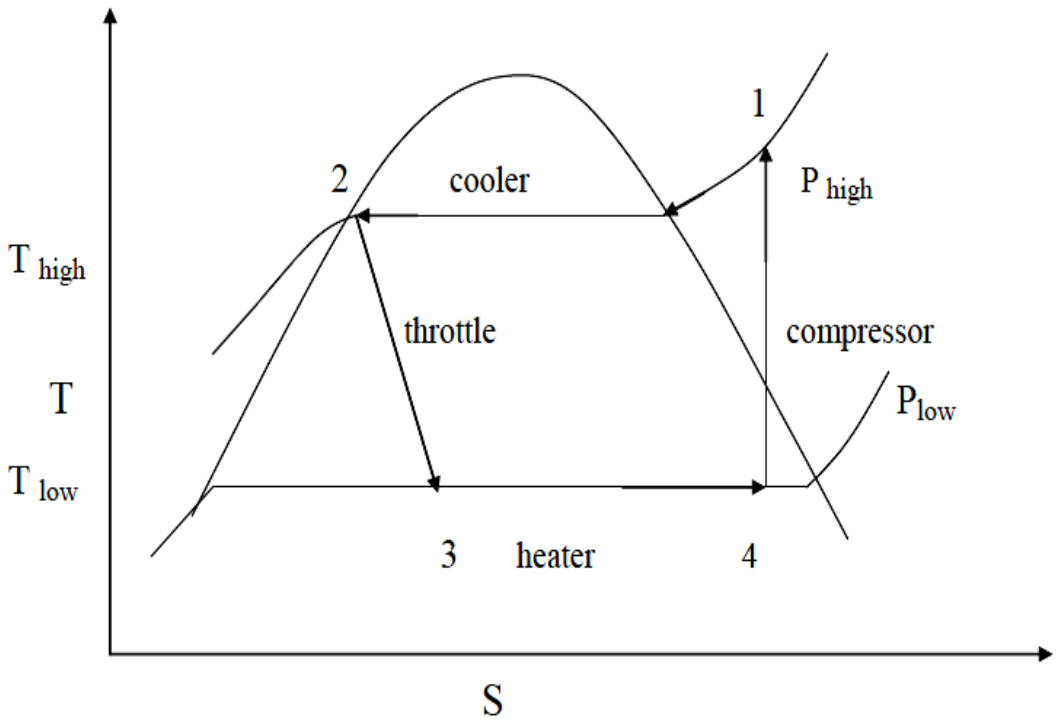


Figure 2

EXPRIMENTAL SETUP

In this system, we use a auxiliary condenser called hot box, this hot box is placed between the compressor and condenser, this box is fitted after the compressor outlet and before condenser inlet. Hence in this changed system, some amount of heat is rejected in auxiliary compressor and remaining heat rejected from simple coil compressor. The effect of auxiliary compressor is sub cooling of the liquid refrigerant block diagram of changed system is as shown in fig. the main parts of the system are an evaporator, from where heat is absorb by the refrigerant; A suction line, A compressor, which extract the vapour refrigerant from the evaporator and compressed them to a high pressure and temperature.

Figure 3. Hot Box

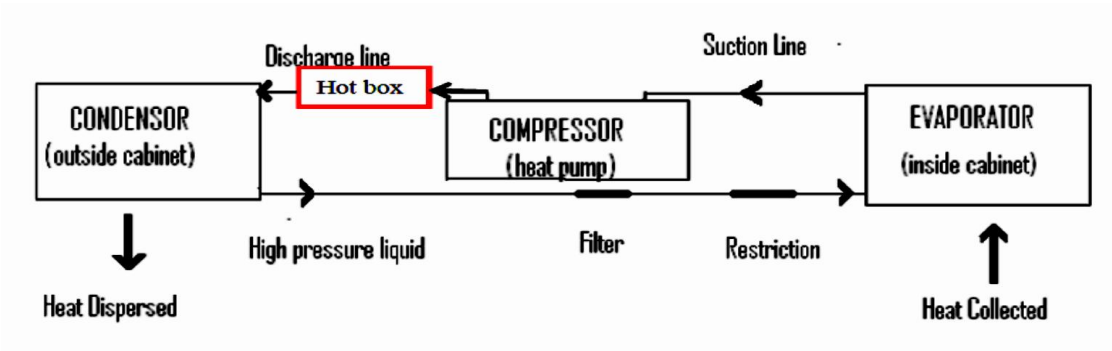


Figure 4. Changed vapour Compression Cycle

WORKING OF CHANGED SYSTEM

A block diagram of a changed vapour compression refrigeration system is shown in figure.4 The main parts of the system are an evaporator, which is used to provide heat transfer surface from which heat can absorb by refrigerant; a suction line, which passes the low pressure vapour refrigerant from the evaporator to the compressor; a compressor, which remove the vapour from the evaporator and increase the temperature and pressure of the vapour; discharge line which delivers the high pressure, high temperature; an auxiliary condenser which act as a hot space by utilizing the waste heat rejected in condenser; a main condenser, through which heat passes from the hot refrigerant vapour to the condensing media.

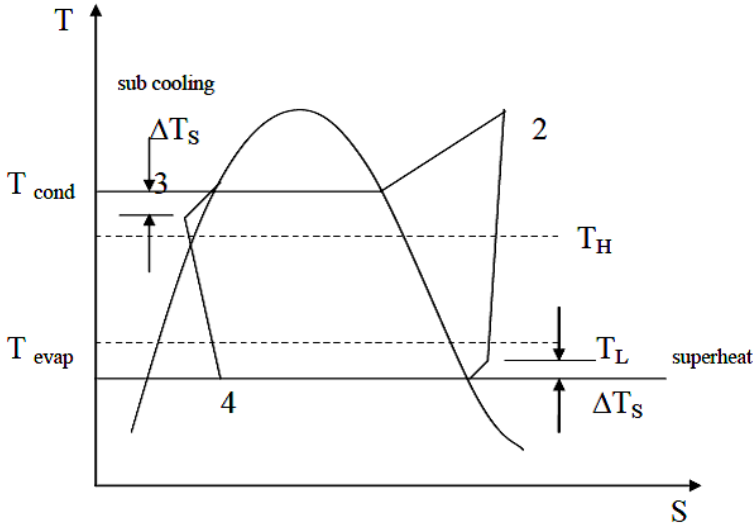


Figure 5: T-S Diagram of Changed System

Glass wood insulation is used for the insulation of hot and the dimension of hot box are as in below table 1

Table 1

S. No.	Parameter	Size
1	Width	14.5"
2	Height	6.5"
3	Breadth	11.5"
5	Glass Wool Insulation	2"
6	Sheet Metal	22 Gange

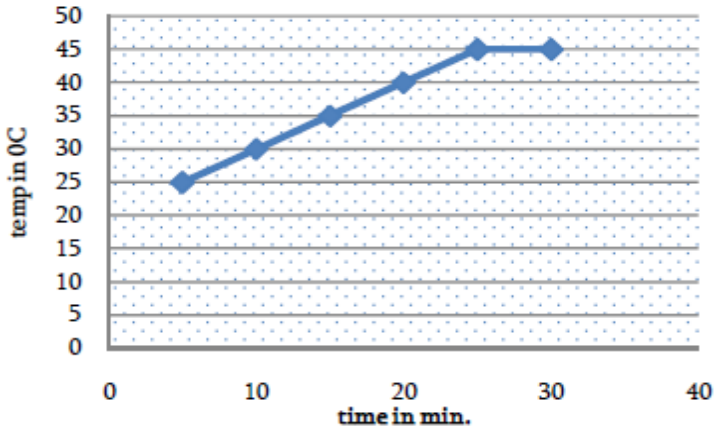
OBSERVATION AND ANALYSIS

In this project a heating facility is provided in domestic refrigerator. At large-scale production, very few amount of manufacturing cost is increased (10% approx.) in comparison of extra facility. Due to this refrigerator can be used for both cooling and heating purpose. This extra facility can also raise the demand of system. This system has cold as well as hot cabinet, so in both conditions (hot as well as cold) this system can be used.

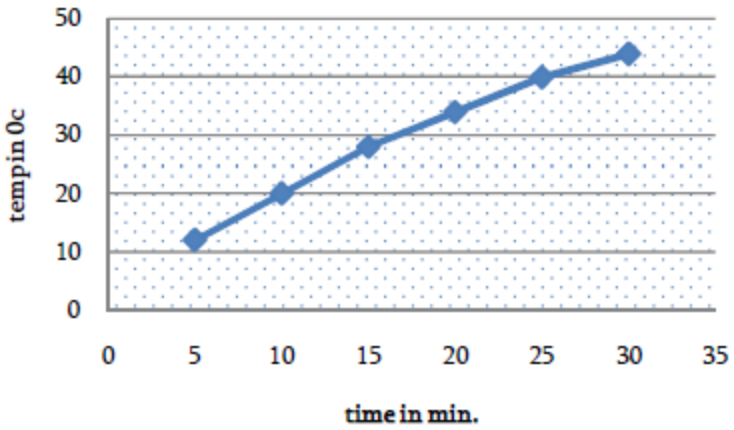
Table 2

S. No.	Substance	Quantity	Time Duration	T1°C	T2°C
1	Water	200 ml	30 min	25	45
2	Milk	200 ml	30 min	12	44
3	Tea	200 ml	30 min	60	56
4	Daal	200 gm	30 min	55	52

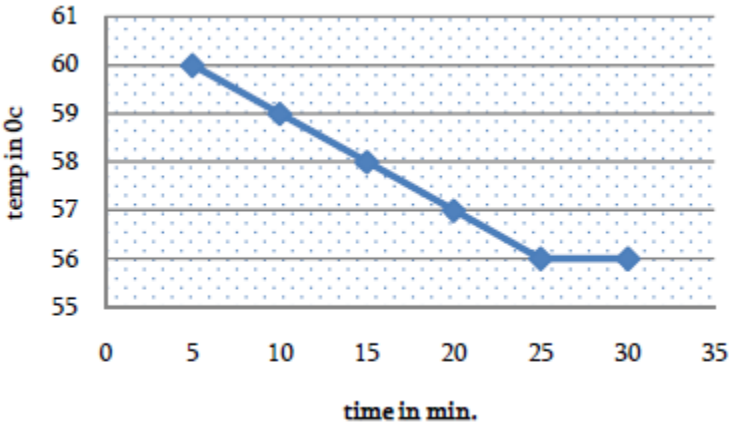
RESULT CONCLUSION



Graph for Water



For Milk



For tea

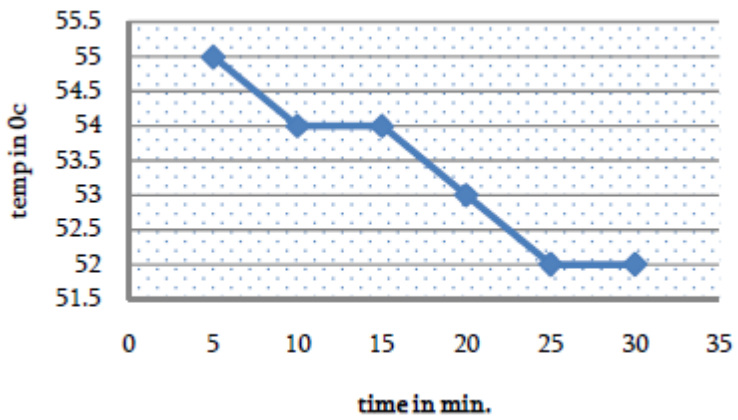


Figure 6. For Daal

The power consumption is same as in simple because the extra facility of hot box is obtained without any extra power consumption, so running cost remains same as in a simple domestic refrigerator. In this system heat rejection in room m is reduced so increment in room temperature becomes less. In this system there is some sub cooling of liquid refrigerant before entering in the condenser is also existed. So when sub cooling is occurred the refrigerating effect is increased and due to which COP of system is increased. In this system a small amount of compressor work is increased due to increase in discharged line so due to which COP of the system is decreased. So all of the above discussion results that in future this changed system may become popular due to both facilities with very small amount of increase in manufacturing cost of the system.

FURTHER IMPROVEMENTS

There are numbers improvements can be possible in the future. Some of the suggestions are as follows:

- Insulation of the hot box can be improved by using advance insulating materials.
- A bypass valve can also be used to divert the refrigerant from hot box when it is not used.
- The water cooling condenser can be used for better cop of refrigeration unit
- An additional fan can be used to cool the gas at the outlet.

DRAWBACK OF CHANGED SYSTEM

The major drawback of the system is that heating depends on cooling. The inside temperature of the hot box depends on the running of the refrigerator. More the value

of cooling, more heat of vaporization and hence more the heat is obtained in the hot box. This hot box is very much successful where the cooling is required for long period or where heavy cooling is required.

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