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THERMODYNAMIC ANALYSIS OF MULTI-PURPOSE REFRIGERATION SYSTEM

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ABSTRACT

Crisis of energy takes place in all over the world. Therefore we need to take the necessary step to solve the energy related issue. In refrigeration system a amount of heat is released from the condenser must be utilized in order to meet energy crisis. By the help of that energy we can use it to meet our domestic purpose. We can use it for heating water, heating tea, and can be used as a thermal flask and so on. We can also control the situation of global warming by utilizing the heat. So it is necessary to utilize the energy in order to meet energy crisis.

Key Words: Energy crisis, Refrigeration System,

I.INTRODUCTION

Whenever the temperature gradient occur within the system heat will transfer from high temperature to low temperature within the body. All the heat flow process obey 1st and 2nd law of thermodynamics. All the heat flow process involve exchange of heat. Heat transfer play an very important role in the field of mechanical engineering so that right equations are calculated and utilized to solve problem related to heat and thermodynamics.

1.1 REFRIGERATION SYSTEM

A household refrigerator is a common household appliance that consists of a thermally insulated compartment and which when works, transfers heat from the inside of the compartment to its external environment so that the inside of the thermally insulated compartment is cooled to a temperature below the ambient temperature of the room. In most cases, household refrigerator uses air cooled condenser. Tetrafluoroethane (HFC134a) refrigerant was now widely used in most of the domestic refrigerators and automobile air- conditioners and are using POE oil as the conventional lubricant. Generally, heat from the condenser side is dissipated to room air. If this heat is not utilised, it simply becomes waste heat . Refrigerator has become an essential commodity rather than need. Very few of us are aware about the fact that lot of heat is wasted to ambient by the condenser of refrigerator. If this energy can be utilized effectively then it will be an added advantage of commodity our project aims towards the same goal. Refrigerator in simple language is removal of heat from the place where it is objectionable and

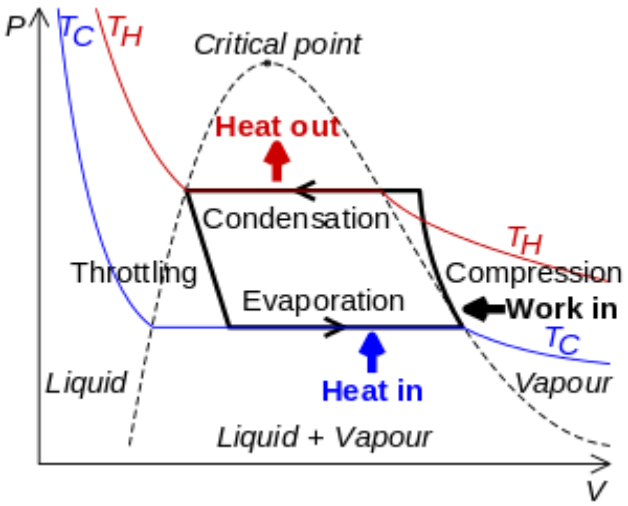
dissipation of heat to the place where it is not objectionable. The working process of the refrigerator is explained as below. The systematic diagram of the refrigerator and its various parts is as shown below:-

A. Compressor: The compressor is the heart of the refrigerator. The input power that is electricity is used to run the compressor. The compressor compresses the refrigerant(R-12 or R-22) which is in the gaseous form to increase its pressure and temperature. The capacity(tons) of the refrigerator decides the power input to the compressor.

B. Condenser: The main purpose of condenser is to transfer the heat generated in refrigerant during the compression process. The temperature of the refrigerant entering in condenser is about 400-600c depending input power of compressor. The atmospheric temperature is about 250-300c. Due to such large temperature difference heat transfer takes place from condenser to atmosphere. That means this heat is wasted to atmosphere.

C. Expansion Tube :capillary tube (small bore copper tube) is used to reduce pressure of refrigerant from condenser to evaporator pressure.

D. Evaporator: This part is placed at the freezer compartment. The working is same as the condenser. The refrigerant boiling in the evaporator tubes takes latent heat from surrounding and in turn cools the space.



II. LITERATURE REVIEW

2.1 Waste Heat Recovery System in the Application of Water Heating

Romdhane ben slama: Developed a system that can recover heat from the condenser of the refrigerator. In this work air-cooled conventional condenser is replaced by another heat exchanger to heat water. The results show that water at a temperature of 60ºC was produced by the system. This paper also analyzed the economic importance of the waste heat recovery system from the energy saving Water and It can be concluded that the system while operating under full load condition gives a better COP as compared to no load condition. Hence if

the system continuously operates under full load, the COP can be improved. The heat absorbed by water has been observed to be highest during full load. The heat recovery technique, which can be applied to a refrigeration system, provides a compound air-cooling and water-cooling. The use of heat recovery system illustrates the improvement in COP and also the reduction in power consumption. The temperature difference obtained between the water inlet and outlet exceeds 10 0C. Thus a more optimum and efficient system can be built to give better results. The heat recovery module can thus be used in various refrigeration applications as well as in air conditioning Patil and Dange: modified a domestic 190 liter refrigerator to recover the waste heat by installing a water tank containing the condenser coils of refrigerator. Experiment showed that maximum temperature increment was up to 40 degree centigrade. But major drawback with this type of arrangement was that it had no mobility and cannot be used for domestic purposes point of view. Shinde, V. Dhanal: presented a case study on Super Heat Recovery

2.2 Waste Heat Recovery System in the Application of Air Heating

S.C. Walawadeet al presents an attempt is made to recover the waste heat from 165 L refrigerator used for domestic purpose. As indicated in this paper, recovered heat can be utilized as food and snacks warmer, water heater, grain dryer. In the proposed system, the basic requirement is to utilize more and more energy (waste heat). For that purpose some calculations are made regarding size and length of condenser and then WHRS is designed. But after different discussions and calculations for heat transfer rates we approached to the final design of insulated cabin with compact construction and with reasonable cost. So as to extract more and more heat, we have mounted two sections of air cooled condenser one at bottom and one at top side of the insulated cabin. This whole assembly is placed on the top of the refrigerator. The main advantage of this design is that we can get maximum heat with minimum losses.

SR	NAME OF AUTHOR	TITLE	JOURNAL/VOL/ISSUE	RESEARCH METHODOLOGY	OVERALL CONCLUSION
1.	1. P. Sarat Babu, 2.Prof.N.HariBabu	Experimental Study of Domestic Refrigerator/Freezer Using Variable Condenser Length	International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 12, Dec 2013	In this experimental work, it is proposed to optimize condenser length for domestic refrigerator of 165 liters capacity. It may give a chance to find a different length other than existing length will	Hence experimental investigations are the best in terms of optimization of certain design parameters

				give better performance and concluded that the optimum length of coil is 7.01m	
2	1. S. C. Walawade 2. B.R. Barve, 3. P. R. Kulkarni	Design& Development of WHR System for Domestic Refrigerator	IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 22781684,PP: 2832,June 2014	An attempt has been made to utilize waste heat from condenser of refrigerator. In minimum constructional, maintenance and running cost, investigated a WHRS and experimented to recover condensation heat from domestic refrigerator of 165 liter.	This system is much useful for domestic purpose. Recovered heat can be utilized as food and snacks warmer, water heater, grain dryer. Technical analysis has shown that it is economically viable.
3	1.Tanaji Shinde, 2. Shailendra. V. Dhanal, 3. Shirish S. Mane	Experimental Investigation Of Waste Heat Recovery System For Domestic Refrigerator	IAEME, Volume 5, Issue 8, pp. 73-83, August 2014	Fabrication, Experimentation and performance evaluation of Waste Heat Recovery System under the following test conditions, 1)Refrigerator 2) Refrigerator-cum-	It can seen system while operating under full load condition gives a better COP as compared to no load condition. Thus more optimum and efficient system

				Water Heater	can be built to give better results.
4	1. N. B.Chaudhari, 2. P. N. Chaudhar	Heat Recovery System from the Condenser of a Refrigerator – an Experimental Analysis	IJTARME, ISSN (Print): 23193182, Volume -4, Issue-2, April 2015	Heat transfer processes by utilizing real life applications such as using waste heat from a condenser of a refrigerator to heat water for residential and commercial use. Heat recovery from condenser of a refrigerator by thermo siphon system because it eliminates the need of a circulating pump	Theoretical COP without heat recovery is about 1.88 and with heat recovery system it is 2.53. The actual COP of air cooled condenser system is 1.078 and For water cooled with heat recovery system practically COP is 3.79
5	1. A. M. Vibhute , 2. Avinash M. Patil	Waste heat recovery in Domestic Refrigerator	IERJ, Special Issue Page 131-133, November 2015	As domestic refrigerators reject large heat inside room which make us uncomfortable in summer due to temperature rise inside the room. So it is now essential to reject this heat outside the room or utilize it for different purposes. Rejected heat is used for keeping food hot, heating	Increase in overall effectiveness of domestic refrigerator and saving in energy. Increase in COP of domestic refrigerator. Efficient and economical combination of refrigerator and food / water

				water which may be used for different purposes	warmer 6
6	1. P. Elumalai, 2. R. Vijayan, 3. K.K. Ramasam 4. M. Premkumar	Experimental Study on Energy Recovery from Condenser Unit of Small Capacity Domestic Refrigerator	Middle-East Journal of Scientific Research 23 (3): 417-420, Dec 2015	Recovered waste heat from condenser unit of a household refrigerator to improve the performance of the system by using a thermo siphon. The effect of operating temperature in the oven and heater for varying operating time of a refrigeration system have all been studied and feasible heat recovery have been ascertained	By this system the power consumption and LPG consumption in a house for heating food items and water can be reduced. Thus the waste energy emitted to the atmosphere is utilized for useful purposes and the demand for power is reduced
7	1.Sreejith K, 2.T.R. Sreesastha Ram	Experimental Investigation of Waste Heat Recovery System for Household Refrigerator	International Journal of Engineering And Science Vol.6, Issue 4 PP 19-23, April 2016	Analysed the system at various load conditions (No load, 40 W load and 100W load). They carried out the techno economic analysis by comparing the waste heat recovery system with the conventional geyser	They found that the waste heat recovery system performs well along with the household refrigerator. This modification made the household refrigerator to be work as both

					refrigerator and water heater
8	Lakshy Soni, 2. Pawan Kumar 3.rahul goyal	Study of an adsorption refrigeration system powered by parabolic trough collector and coupled with a heat pipe	Imperial Journal of Interdisciplinary Research Vol-2, Issue-8,ISSN: 2454-1362,May 2016	To utilize waste heat from condenser of refrigerator. This system is nothing but a cabin that they are going to install over the head of the simple refrigerator this cabin will be an arrangement of coils that will work as a heat exchanger.	The results show that water at a temperature of 60ºC was produced by the system. If this system is established all over world, excessive amount of LPG gas gets saved.

III.CONCLUSION

From the above conclusion, we have concluded the there are various method to utilize the heat rejected by the refrigerator. The heat rejected by the condenser can be utilized for various domestic and other purposes. This can able to compensate the losses made by energy crisis and also reduce the problem related to global warming. However the heat released by condenser is not so large that we can cook food but we can used it for smaller task like heating food, boil milk and water to 40-50^{0}C where people , now a day's use microwave oven which consume electricity. However this cannot meet the whole need of us but we can say that something is better than nothing.

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