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A Review on Developing a Model that Uses Waste Heat from Condenser in VCR Cycle

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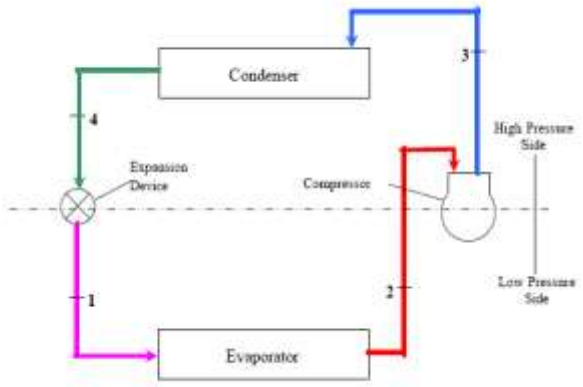
Abstract - Vapour compression refrigeration system is generally used for producing refrigeration effect. It provides both refrigeration effect and heat rejection from condenser due to chemical properties of refrigerant. The Heat rejected from condenser is high and it goes waste to the environment. . We utilize that heat for some domestic purpose like an Oven. For that we can add a new equipment like hot box. We collect the waste heat from the condenser through heat into hot box or hot chamber. We can providing an insulation to the hot box .we are utilize that hot box as an oven. The Energy Released from the condenser in the form of thermal or heat energy is utilized in place of condenser for useful work. This useful work is made to realization in different types of uses in industries, Central Malls, Power plants. We can utilize the thermal energy which is going to be wasteful in the atmosphere to operate a small oven in small units.

Key words: VCR Cycle, Waste Heat, Hot box, skin condenser

I. INTRODUCTION

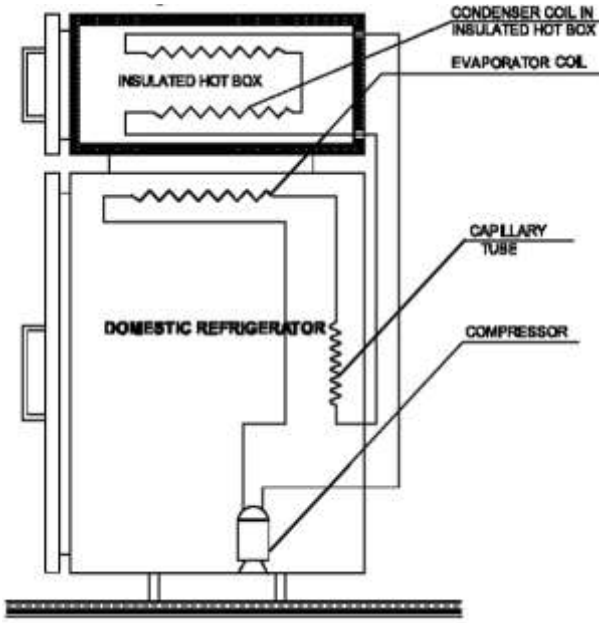
In a basic vapors compression refrigeration cycle, there are 4 components. (1)Compressor (2)Condenser (3) Expansion device (4) Evaporator. First, the refrigerant is compressed in the compressor from low temperature to high temperature. After that the high temperature refrigerant is condensed in the condenser to low temperature at constant pressure After that, it pass through expansion valve where the pressure is decreases so as that of temperature and then it pass through evaporator where we get the refrigeration effect.



Here the heat is continuously rejected to atmosphere, so our purpose is to utilize the heat and to maintain the cop.

II. LITERATURE SURVEY

1) **A.M.Vibhute, Avinash patil** had constructed a model that uses waste heat from condenser and that heat is apply to the compressor. So by that experiment, he concluded that the COP of the system without waste heat recovery is 1.1 and with waste heat recovery is 1.21. So COP of the system increase about 10.91% with waste heat recovery.



2) **S.N.Vedil , A Kumar** utilized the waste heat from VCR cycle to run VAR cycle. He conclude that the waste heat from condenser is not enough to run the VAR cycle so extra heat is applied by solar energy. And they found that by this method, the COP of VAR cycle is increased by 10.5%.

3) **Raut digambar, N Narawade** have develop the model with water heater and a hot box and both are operated by valve mechanism. They concluded that they perform the best result and get the temperature of water heater about- 45-50 degree and the temperature of hot box is 55-60 degree.

4) **Dhananjay parmar and Nilesh soni**. Utilize theWaste Heat From a Domestic Refrigerator by recovering heat using water heater chamber in between compressor and condenser. With the help of blower fan.

5) **Muhammad Asima, Micheal K.H.Leguna** have published a research paper in which the authors have investigated the performance of the i-AC-ORC system. They find that the performance greatly depends on the initial performance of the AC subsystem. An AC system with better performance leads to better overall performance when combined with the ORC subsystem. R600a is selected as the working fluid for the AC subsystem when the operation is under restrict safety control due to its flammability.

6) **Nishith Desai, Surendra Singh** published a research paper on waste heat from Rankine cycle to run a cascade vapour compression-Absorption cycle. They find that the energy efficiency of the decreases with increase in operating temperature of VCR. However the efficiency of the system increase with increase in disorber temperature, cascade condenser temperature and degree of overlap.

7) **N.B.Chaudhari and P.N Chaudhari** publish a paper on Heat transfer processes. He utilize heat in 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. He investigate that the theoretical COP without heat recovery is 1.88 and COP after the heat recovery 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.

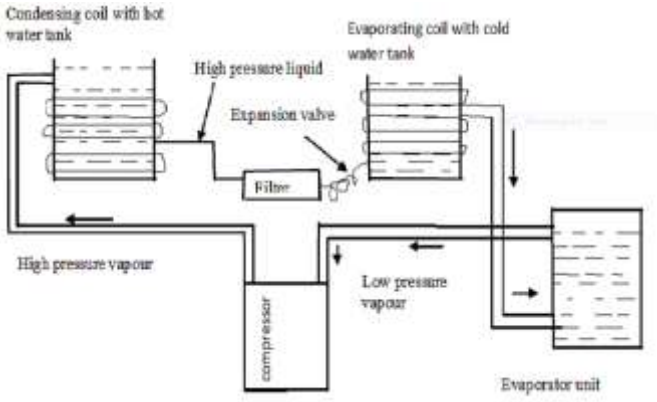
8) **A.S.Katkarand L. Dhale** Developed and tested a with integrated heat recovery system which is designed both to enhance the performance of a domestic refrigerator and simultaneously recovers heat using water heat exchanger. The performance was investigated and he found that that the cop of the R134a system was improved by 9%. A spiral tube heat exchanger unit installed in parallel to air cooler condenser and experimental results are recorded and analysed.

9) **S.C.Walawade, B.R.Barve and P.R. Kulkarni** have attempted to utilize waste heat from condenser of refrigerator. Two sections of air cooler condenser one at the bottom and one at the top of insulted cabin are mounted that there is improvement of 11.81% in cop of system by recovering 9.92w of heat by water.

10) **S.N.Sapali et al** have investigated to utilize waste heat of condenser of a bulk milk cooler using shell and coil type heat exchanger. The result shows that complete superheat and 35% of latent heat is recovered and C.O.P. of the system is increased from 3 to 4.8. This hot water is utilized for cleaning equipment's by varying water circulation. The results are discussed which concludes that 53 to 65% of total heat lost is recovered in heat exchanger.

11) **Romdhane ben slama[1]** developed a system that ca recovers the heat from the condenser in the refrigerator. In this work air-cooled conventional condenser is replaced by another heat exchanger to heat water. By this system, we can get water at temperature around 60 degree. This paper also analyzed the economic importance of the waste heat recovery system from the energy saving point of view.

12) **Raman kumar singh and Saif Nawaz Ahmed** Develop a system For making this system multifunctional, flexible and economical Condensing coil is immersed in water to be heated and a part of cooling coil 1st passed through filled water tank in which water is to be cooled and then remaining coil is utilized for cooling of air so that desired space to be cooled. Hence here cooling of air, water and heating of water all the three process is done simultaneously in a single unit. The heating unit in the system utilizes heat lost through the condenser and thereby saving energy, by the utilization of wastage of heat energy performance of the system has improved significantly.



13) **M. M. Rahman** et al. **[12]** developed a heat recovery system which can recover heat from a split air conditioning system. In this case, 60 litre heating tank is designed in a way that the copper tube conveying refrigerant is not submerged in water. The heating recovery tank consists of two cylindrical chambers, the inner chamber, is filled with water, is coiled with the hot refrigerant carring tube at the outer surfaces. It was found that this heat recovery system improved the compressor efficiency and at the same time continuously supplied warm water for domestic purpose. This system rejected less heat to the environment so it is safer in environmental aspects.

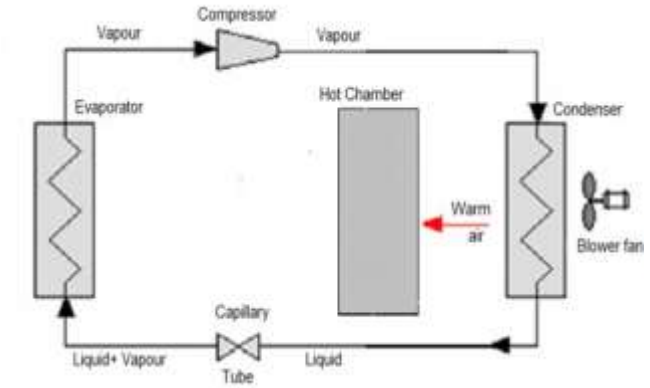
14) **B.Saleh** study the combine OCR(Organic rankine cycle) and VCR(Vapour compression cycle) in which the VCR cycle is powered by waste low grade energy from OCR. He study both energy and exergy analysis if the system.

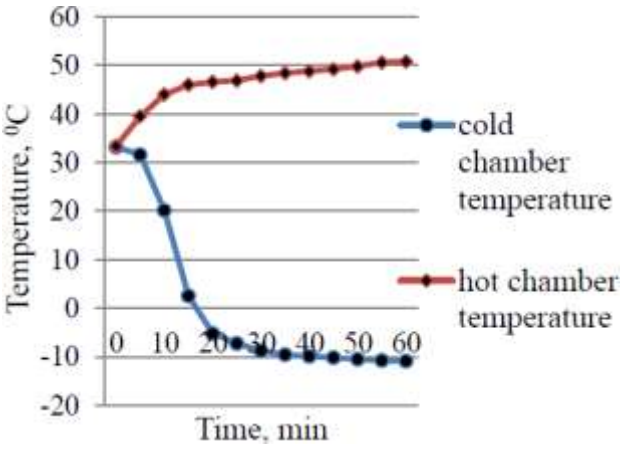
15) **S.B.Lokhande & Dr.S.B.Barve** have done experiment on Godrej refrigerator with 165 litre capacity. A hot case on top side of refrigerator is installed with the system for food or milk heating purpose.

16) **S.C. Kaushik** et al presents an investigation of the feasibility of heat recovery from the condenser of a vapor compression refrigeration (VCR) system through a Canopus heat exchanger(CHE) between the compressor and condenser component. The presence of the CHE makes it possible to recover the superheat of the discharged vapor

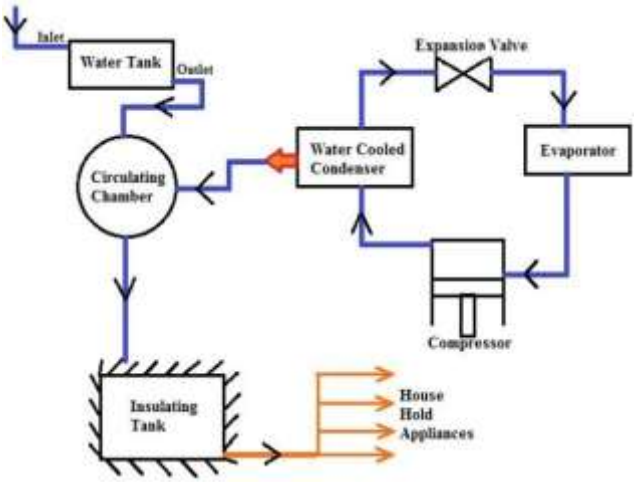
and utilize it for increasing the temperature of the external fluid (water) removing heat from the condenser. The effects of operating temperatures in the condenser and evaporator for different inlet water temperatures and mass flow rates on the heat recovery output and its distribution over the condenser and CHE (the fraction of the condenser heat available through the CHE),the available outlet water temperature and heat recovery factor have all been studied and optimum operating parameters for feasible heat recovery have been ascertained. The parametric results obtaine for different working fluids, such asR- 22, R-12, R-717 & R-500, have been presented. It is found that in general, a heat recovery factor of the order

17) **Varghese et al.** have illustrated the practical feasibility of the heat recovery system to extract heat which is waste from the condenser exit of the refrigerator and use it for heating. The shown work, attempted to retrieve the waste heat out of a 210 L refrigerator, intended for residential requirements. The top chamber of the refrigerator was made as a hot chamber, by extension of the condenser coils, and the connection of the top section, towards top surface of the lower chamber of the refrigerator. Hot chamber and the cold chamber had temperature difference inside hence, was analysed considering the different variables considering the aspects of time, capacity of chamber and load. From the outcomes, it had been founded that the mentioned technique of heat recovery, could be engineered and developed for each and every domestic refrigerator, with the nominal cost. Thus, the reuse of waste heat provided method for optimum energy conservation. This kind of work could be improved by providing better insulation which in turn reduces the heat loss and increases the performance of the system.





18) **Stalin et al.** have focused on the hypothetical evaluation of fabrication of domestic hot water and decline of LPG gas employing air conditioner waste heat. An effort had been taken to retrieve waste heat discarded by 1 TR air conditioning units. With this water-cooled condenser is applied as well as water is enacted by pumping till required temperature is obtained. Then hot water was collected in well insulated container for use. The end result of the paper demonstrates that the temperature of hot water, time needed for obtaining that temperature for the specified volume of water and the lowering of LPG gas by utilizing hot water is additionally discussed. Factors like supply and demand, condenser coil design are considered and hypothetically determined. At last this might be the replacement for hot water heater and so it fulfils most of the applications of hot water. Likewise, it could possibly tackle the requirement of LPG gas.



19) **Soni** have developed ways to use waste heat coming from condenser of refrigerator. This kind of heat can be employed for number of residential and commercial reasons. In minimal constructional and service cost this method is considerably useful for residential motive. It could be beneficial alternative solution to increase functionality and reuse the waste product which is in heat form. The study has unveiled that such process is practically feasible and financially feasible. This system discarded less heat to the

natural environment therefore it is safer in environmental attributes.

20) **R.A Clark *et al.*** described the design, construction, and testing of an integrated heat recovery system which was designed both to enhance the performance of a residential refrigerator and simultaneously to provide preheated water for an electric hot water heater. The particular opportunity investigated in that study was to preheat the supply water for a hot water system using refrigerator condenser waste heat. An economic analysis revealed that a savings of 18.3 % on the water heater operating cost was possible. The refrig. R- 12 used in that project was not friendly to the ozone layer. The time to increase the temperature of water of 30 in the no use test was fivedays. Thus the apparatus developed in this experimental study did not heat water quickly enough.Sanmati Mirji .

III. OVERVIEW OF RESEARCH PAPERS

 Heat recovery system enhance the performance of the system and simultaneously recover the heat.

 Waste heat from the VCR cycle can be used as Oven and Heater.

 With the help of of waste heat utilization in VCR system we can increase the COP of the system by 10.5%.

IV. CONCLUSIONS

- From the above research we can conclude that waste heat recovery is very useful to increase COP of the system.

 -We can also apply the concept of skin condenser and a hot box so that we can utilize the waste heat as an oven or a water heater and maintain the COP of the system as actual model.

-With waste heat recovery , we can reduce environmental pollution as well as save power consumption.

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