Utilization of Waste Thermal Energy from VCR Cycle

Firoj Pathan[1] Sanchit Gandhi[2] Mahesh Kachhiya[3] Aman Sharma[4]
[1,2,3,4]Department of Mechanical Engineering
[1,2,3,4]Vadodara Institute of Engineering, Kotambi, Vadodara, Gujarat Technological University, Vadodara–391510, Gujarat, India

Abstract— Vapour compression refrigeration system is most commonly and domestic as well as large scale method of producing refrigeration effect. One hand these systems provided quick refrigeration effect and heat rejection on other hand by the chemical properties of refrigerant. The quantity of rejected heat from such systems is quite high and this heat is removed in atmosphere as a waste. We utilize that heat for some domestic purpose like an Oven. For that we implement new component in the system like exhaust fan, hot box, etc... We are collect the waste heat from the condenser through exhaust fan collecting that heat into hot box or hot chamber. We are providing an insulation to the hot box .we are utilize that hot box as an oven.

Key words: VCR Cycle, Waste Heat, Condenser

I. INTRODUCTION

A basic vapour compression refrigeration system consists of four essential components, namely compressor, condenser, expansion valve and evaporator. The individual performance characteristics of these components have been discussed in earlier lectures. However, in an actual system these components work in unison. The performance of a complete system is a result of the balance between these four components. For example, when the heat sink temperature varies, it affects the performance of the condenser, which in turn, affects the performance of the expansion device, evaporator and the compressor.

In principle, the balance point for the system can be obtained either by a graphical method or by an analytical method.

II. RESEARCH PAPER

1) A.S.Katkarand L. Dhale [1] had constructed and tested an integrated heat recovery system which has been designed both to enhance the performance of a domestic refrigerator and simultaneously recovers heat using water heat exchanger. The performance has been monitored using instruments and results shows 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.
2) T Patel et al [2] have reviewed previous work in area of waste heat recovery from condenser of domestic refrigerator in terms of background, originally, current status, and researches.
3) Serenity K. et al [3] have investigated the performance of household refrigerator using air-cooled and water-cooled condenser. The experiment was done using HFC 134a as the refrigerant and polios-ester oil (POE) as the lubricant. Performance of the household refrigerator air-cooled and water-cooled condensers were compared for different load conditions. The result shows that there is reduced energy consumption for water cooler condenser up to 11%. About 200 litters of hot water at a temperature of about 58º cover a day can be collected from the system from igloo kelvinator refrigerator.
4) P. Elumalai et al [4] investigated experimentally the heat recovery by using hot oven and heater of VCR system. The oven recover's the superheat of the refrigerant vapour and utilize it for heating space inside the hot oven. A juice chamber is designed to reduce its temperature by pumping it through heat exchanger attached to evaporator. The effectiveness of cooler as well as the effect of operating temperature has been studied. The result shows that temperature in oven is 48ºc and 42ºc in water. After a period of 30 minutes running of 165 litters, 124 watts R134a refrigeration system.
5) Y.A.Patil and H.A. Dange [5] have published a research paper in which the authors have investigated a waste heat recovery system with thermo siphon and experimented to recover condenser heat from the household refrigerator of 200 litters. Tests are carried out at different load conditions to measure cop and performance of the system. It is observed that 100 litters of water in water tank gets heated up to 40ºc within 8 hrs. Of average load conditions.
6) T.Agarwal et al [6] installed a cabin at the top of domestic refrigerator with condenser coils inside the cabin for heating water. It was concluded that there is increase in cop of system up to 11% copper coils of diameter 4.36mm and length 620 cm were installed inside the cabin and average amount of heat added to water is calculated to be is 8 watts.
7) Raut D.M.et al [7] described a multipurpose refrigerator with hot box and water heater. The discharge line of compressor is bypassed before air cooler condenser to water tank and hot box. The water tank of 1.5 liters capacity gets heated to 50ºc in 35 minutes and hot box heats up to 45ºc in same time when operated alone.
8) G.G.momin et al [8] have done experimental on 17SL LG refrigerator and observed that 100 litters of waste water gets heated up to 60ºc within eight hours at average load from the condenser waste heat recovery system. It consists of water tank of capacity 5 litters through which water is flowing and refrigerant tube is brazed helically on it.
9) Reny Varghese et al [9] have done retrofitting of condenser of domestic refrigerator for heat recovery. The condenser coil is placed in a hot chamber and the evaporator is moved from top to the bottom chamber. The deep freezer is used as a hot chamber by replacing evaporator coil by condenser coil.
The performance analysis shows there is 9.92w heat recovered through water and a 12.26% increase in cop is achieved.

10) S.N.Vedil and A Kumar [10] have proposed a combined VCR and VAR cycle in which waste heat of condenser is utilized to run a bottoming cycle I.e. VAR where generator gets the heat from condenser of VCR cycle as well as solar energy. A R12 VCR system performance is improved using NH3-H2O VAR system. Theoretical analysis indicates 10.5% increase in cop of system.
11) S.C.Walawade, B.R.Barve and P.R. Kulkarni [11] 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.
12) N.B.Choudhari and P.N.Choudhar [12] have designed a heat recovery system from the condenser of 145w Godrej refrigerator. A heat exchanger with 50 litter's water tank is constructed for heat recovery using thermos siphon effect. Results indicate that 7.2 litre water at 51°c is available per hour.
13) S.B.Lokhande & Dr.S.B.Barve [13] 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.
14) T.B.shinde et al [14] have done experimentation and performance evaluations of a waste water heat recovery system by using a water tank for condenser heat absorption of 200 L LG refrigerator experiments were performed with and without heat recovery system and result shows that there is 10°c increase in water outlet temperature.
15) S.N.Sapali et al [15] 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.

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.
- By the use of waste heat utilization in VCR system we can increase the COP of the system by 11%

IV. Conclusion

- From the above overview of research paper we can conclude that the waste heat recovery will increase the performance of the system as well as it will increase the COP of the system.
- Heat recovered from the system can be used as Oven or Heater.
- We can run extra appliance with the one system so this will reduce the power consumption.

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