Waste Heat Utilization from VCR cycle for food preservation

[1]TEJAS S. LEUVA,[2]DHANANJAY H. JOSHI,

1PG student, ME THERMAL, LDRP ITR, KSV University, Gandhinagar, India,

2Professor , ME THERMAL, LDRP ITR, KSV University, Gandhinagar, India.

Abstract : The vapor compression cooling gadget is generally used to provide a cooling effect. It offers cooling and warmth rejection effect of the condenser due to the chemical properties of the refrigerant. The rejected heat of the condenser is excessive and is wasted within the surroundings. . We use that heat for some home reason like an oven. For that we are able to add a brand new equipment as a hot box. We accumulate the residual warmness from the condenser via the warmth to the hot field or warm chamber. We can offer insulation to the hot field. We are the use of that warm box as an oven. The strength launched from the capacitor within the shape of thermal or thermal power is used instead of the capacitor for beneficial paintings. This beneficial paintings is carried out in exclusive forms of makes use of in industries, important purchasing centres, power flora. We can use the thermal energy so as to be a waste in the atmosphere to operate a small oven in small gadgets.

Keywords: VCR Cycle, Waste Heat, Hot box, skin condenser.

I. INTRODUCTION

Refrigeration is a manner that works to transport warmth from one area to every other. Heat delivery work is traditionally driven by way of mechanical work, however it can additionally be pushed by warmness, magnetism, electricity, laser or different way. Refrigeration has many packages, however it is not confined to domestic refrigerators, business freezers, cryogenics and air agriculture and agreement styles. Refrigeration has had a extraordinary impact at the industry, lifestyle, The concept of keeping food dates back to the ancient Roman and Chinese empires. However, refrigeration generation has advanced hastily in the ultimate century, from ice harvesting to railroad motors with controlled temperature.

Vapor Compression Refrigeration Cycle:

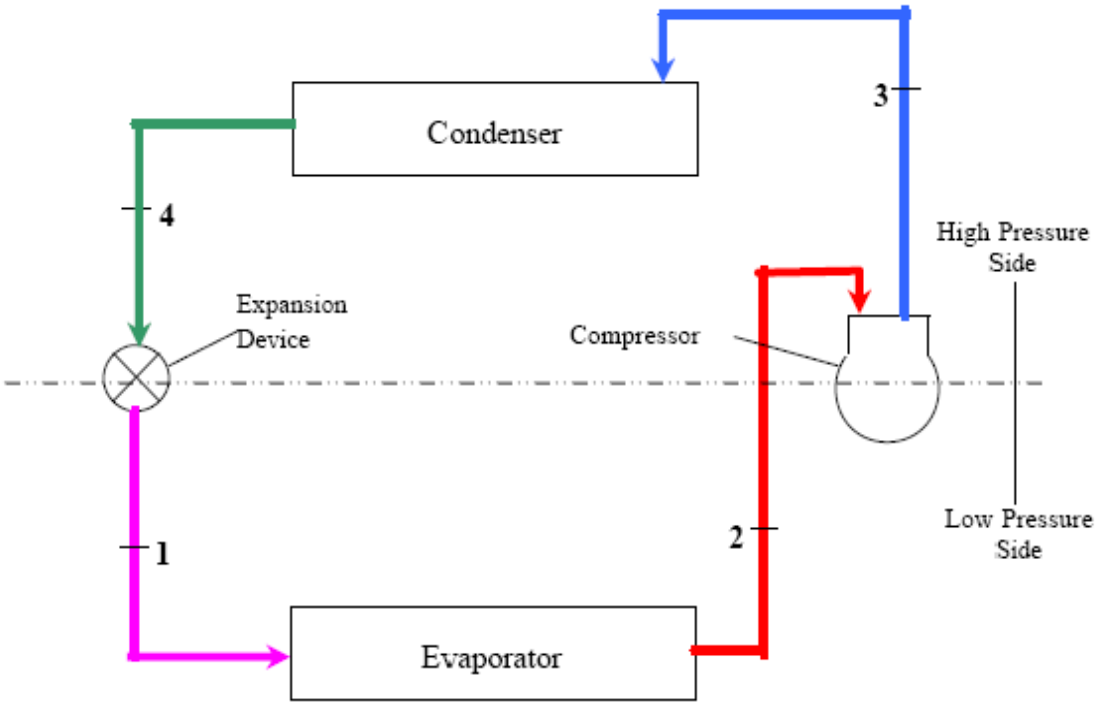

FIG: 1

The circulating refrigerant enters the compressor in the thermodynamic state called saturated steam and is also compressed at a better stress and temperature.Then, the superheated steam, at a temperature and pressure at which it may be condensed with cooling water or cooling air. That warm steam is directed through a condenser wherein it cools and condenses right into a liquid because it flows through a coil or tubes with bloodless water or bloodless air flowing through the coil or tubes. And the circulating refrigerant rejects the heat of the device and the water or air takes away the rejected heat. The cold aggregate is directed to the evaporator. A fan circulates the hot air inside the enclosed area through the coil or the tubes that delivery the

bloodless coolant and the steam aggregate. That hot air evaporates the liquid part of the cold refrigerant combination. At the identical time, the circulating air cools and, consequently, lowers the temperature of the closed area to the favored temperature. The evaporator is in which the circulating refrigerant absorbs and removes the warmth this is subsequently rejected within the condenser and transferred to another part by using water or air used within the condenser.

II. MODIFIED VCR SYSTEM

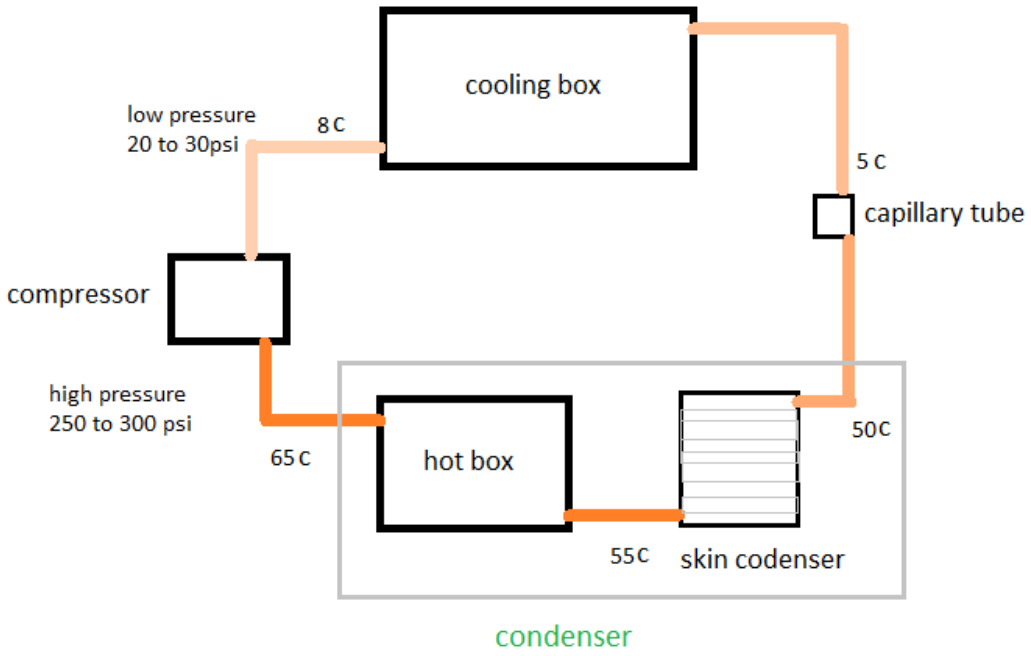

FIG: 2

The simple principle of the modified VCR system is the same as the VCR machine.

- Simply run a colder liquid or gasoline constantly across the object to be cooled. This will cast off warmness from the object.
- High strain and temperature air entered the recent field and heat is absorbed by means of the food placed within the field.
- After leaving the new field, the air enters the capillary, wherein the air temperature is decreased.
- Cold air enters the bloodless field, wherein bloodless air absorbs warmness from the material positioned within the field.
- The closed refrigeration cycle works in step with this precept.
- Here we use skin condenser so that the steam which not condensed in hot box will be condensed in a skin condenser.
- By this the proper condensation will occur so that it will not affect the performance of the system.

III. EXPERIMENTAL SETUP

FIG:3

- The steam refrigerants that are compressed under excessive temperature and high strain situations within the compressor, grow to be excessive temperature and high pressure liquid refrigerant that passes through the condenser, after which come to be low temperature and occasional stress liquid refrigerants when going through the capillary tubes

- Low temperature and coffee pressure liquid refrigerants soak up the encircling heat at the same time as evaporating within the evaporator and are absorbed by the compressor becoming saturated steam.

IV. RESULT AND DISCUSSSION

WITH HOT BOX													
SR.NO	P1(psi)	P2(psi)	T1	T2	T3	T4	TB	TH	TW	UTILISATIC	RE(KW)	WC(KW)	COP
1	12	160	8.5	71.1	42.1	8.4	24.2	56.5	44.2	469.98	0.415	0.149	2.785235
2	12	162	8.4	72.5	43.3	8.3	24.2	57.1	45.1	491.1291	0.419	0.153	2.738562
3	13	164	8.1	73.3	44.2	8.1	24.2	58.8	46.2	516.978	0.422	0.156	2.705128
4	14	165	7.5	74.5	44.9	7.6	24.2	59.6	46.5	524.0277	0.427	0.161	2.652174
5	14	166	7.1	75.1	45.2	7	24.2	61.1	47	535.7772	0.433	0.168	2.577381
6	14	167	6.3	75.7	46.1	6.5	24.2	63.5	47.8	554.5764	0.436	0.171	2.549708
7	16	169	6.1	76.2	46.6	6.4	24.2	64	48.6	573.3756	0.442	0.177	2.497175
8	17	172	5.9	77.1	46.9	5.8	24.2	64.7	49.5	594.5247	0.45	0.182	2.472527
9	17	175	5.4	78.2	47.1	5.5	24.2	65	50.7	622.7235	0.459	0.186	2.467742
10	18	179	4.2	80.2	47.3	4.2	24.2	65.7	52.8	672.0714	0.47	0.191	2.460733
11	18	181	3.9	82.3	47.8	3.9	24.2	66.2	53.6	690.8706	0.479	0.195	2.45641
12	19	185	3.3	85.1	48.1	3.3	24.2	69.8	54.8	719.0694	0.51	0.211	2.417062

TABLE :1

WITHOUT HOT BOX									
SR NO	P1(psi)	P2(psi)	T1	T2	T3	T4	RE	WC	COP
1	11	166	9.1	69.2	39.4	9.2	0.419	0.151	2.774834
2	12	169	8.4	72.4	40.8	9	0.424	0.155	2.735484
3	12	171	7.2	75.6	42.2	7.4	0.431	0.165	2.612121
4	14	174	5.1	78.9	44.5	5.6	0.436	0.173	2.520231
5	15	175	4.7	79.7	45	5.1	0.441	0.178	2.477528
6	17	179	3.6	81.6	45.8	4	0.447	0.184	2.429348

TABLE :2

CALCULATION:

(1)The work done by the basic VCR system compressor is calculated as follows:

$$W_C = \dot{m}\,(h2 - h1)\text{KW}$$

Where h2= enthalpy at the exit of compressor

h1=Enthalpy at the inlet of the compressor.

(2)The refrigeration effect can be calculated as follows.

$$\text{RE} = \dot{m}\,(h1 - h4)\text{KW}$$

h4= Enthalpy at the end of expansion device

(3) COP of the system can be calculated as follows:

$$\text{COP} = \text{RE}/W_C$$

Heat Utilisation Calculation.

Tb=Initial temperature of water

Tw=Final Temperature of water

The amount of heat utilisation can be calculated as follows:

(4) Heat Utilisation= mc(Tw-Tb) W

m= mass of the water inside the hot box

C=specific heat of water

GRAPHS:

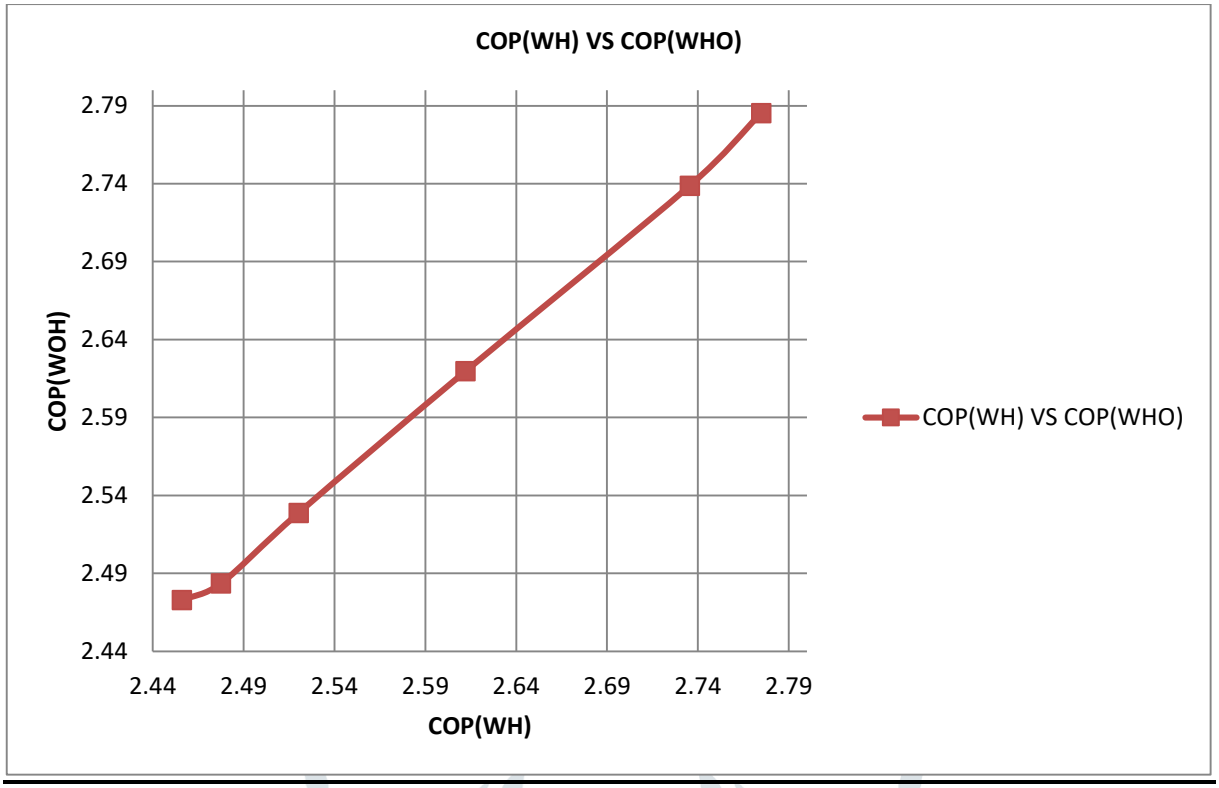

FIG 4

As per this graph, we can say that the COP remains almost same in with hotbox and without hot box.

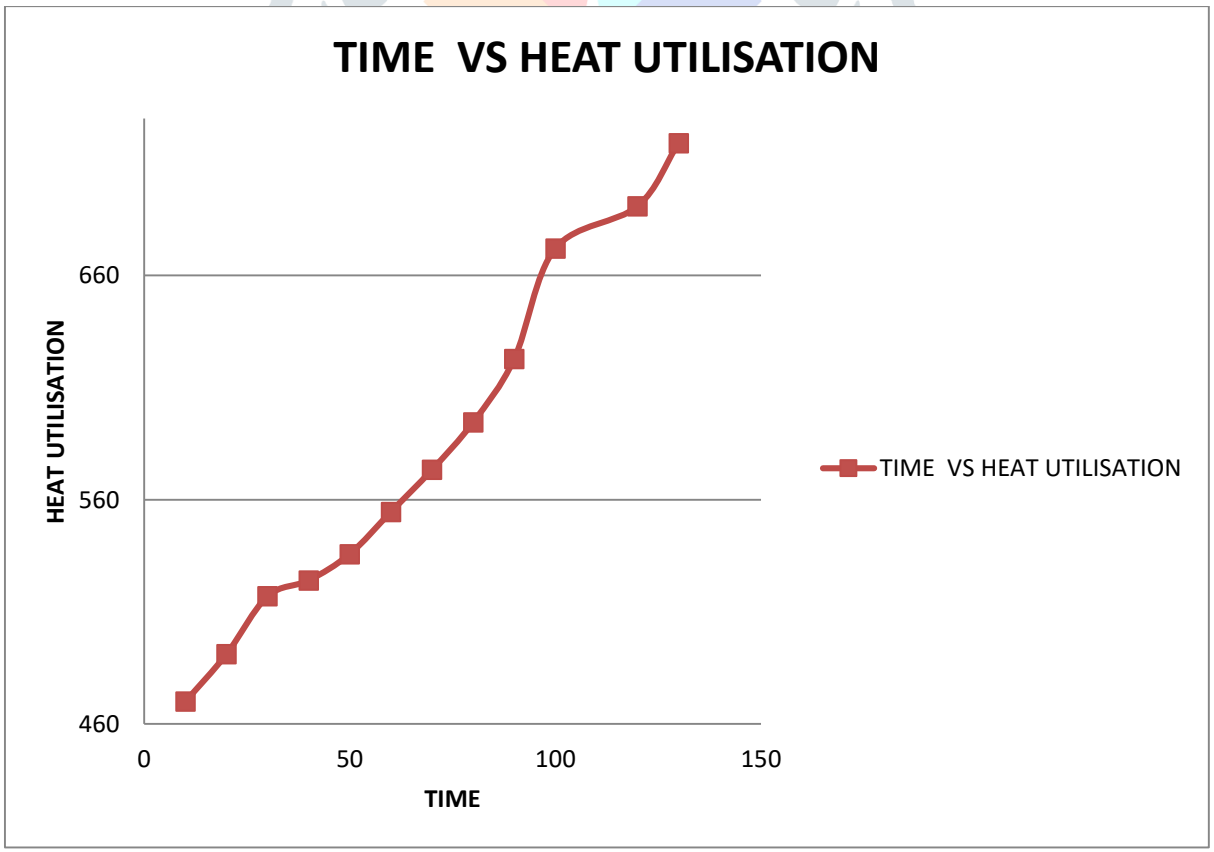

FIG 5

As per the graph, we can say that the time increases, the heat utilization from condenser increases.

- So as per above discussion we can see that heat utilisation is increasing with increase in time because the condensation

temperature is increasing with time.

- We take the reading at ten minute intervals, so in the initial conditions less heat is used because less heat is rejected to the hot box. As time increases, the heat rejected to the hot box increases and therefore the heat utilization increases and we obtain the maximum heat used around 720KJ.
- Here we use skin condenser so that's why the proper condensation of the refrigerant occurs and the refrigerant which is not condensed in a hot box will be condensed in a skin condenser.
- We can also see that the COP of the model without hotbox is almost same as that of with hot box. So we can say that heat utilisation from condenser does not affect the COP. We apply water inside the hot box and measure the temperature with time.
- Increase in time will increase the temperature of hot box and that of water increases because load on the compressor increases so that the condensation temperature increases so more heat will be rejected to the hot box and more heat we can utilise.
- For calculation of heat utilisation, we use water because it's easy for calculation so by that, we get the maximum water temperature around 55 ^{o}C. So the maximum heat utilisation can be calculated easily and we get the maximum heat of 720 KJ. That we can use for various purpose.
- As mentioned earlier point the COP of the system remains same so that we utilise the waste heat without any external loss.

V. CONCLUSION

- By this experiment, we can conclude that we can utilise the waste heat from condenser for various purpose of heating and food preservation.
- We get the maximum temperature of water around 55 ^{o}C so we can use that water in hotels for hand wash.
- By this experiment, the heat utilise without any external source. So by that, we can also save electricity.
- The COP of the system of with hot box and without hot box is same, so the performance of the system does not change.

VI. REFERENCES

1)A.S.Katkar, L Dhale , Coefficient of performance increment in domestic refrigerator: A literature review IJERT vol 3 issue4 page no 768-772,April 2014

2)T Patel, N Medhane , Y Manapure , K Nagmoti Prof Dube A "A review on recovering waste heat from condenser of domestic refrigerator" ,IJSRM Vol 3, issue 3, page 2409-2414, march 2015.

3)Serenity K, Sushmita S, Vipin Das "Experimental investigation of a household refrigerator using air cooler and water cooler condenser" international journal of engineering and science. Vol. 4 ,issue 6 ,page no 13-17,
June 2014

4)P Elumalai, R Vijayan K, Ramasami M, Premkumar, "Experimental study on energy recovery from condenser unit of small capacity domestic refrigerator", middle east j sci res Vol 23, issue 3,page no 417-420, 2015

5)Y.A.Patil and H.A. Dange "Improving the performance of household refrigerator by recovering heat from the condenser" IJSR volume 2. Issue 6 page no 303-305 June 2013

6)T. Agarwal, M. Kumar, P. Gautam "Cost effective cop enhancement of a domestic air cooler refrigerator using r-134 a refrigerant", IJETAE Vol 4 issue 11, page no 303-305, November 2014

7)Raut D.M."heat utilization from refrigerator condenser using water heater and hot box", international journal of multidisciplinary research and development,vol 2 issue 6 page no 50-55 June 2015

8)G.G. Momin, S.R. Deshmukh, M.T. Deshmukh, "cop enhancement of domestic refrigerator by recovering heat from the condenser", international journal of research in advent technology. Vol 2 issue 5 page no 402- 406 may 2014

9)Reny Varghese and M. Rohit "heat recovery. System in domestic refrigerator",IJRDTvol 2 issue 2 page no 16-20 August 2014 .

10)S.N. Vedil And A. Kumar "waste heat utilisation of vapour compression cycle" IJSRP vol 4 issue ll page no 1-4 Nov 2014