INCREASING C.O.P OF VCR BY USING DIFFUSER

V. Harinath[1], A. Kalyan Charan[2]

[1]*Assistant Professor, Mechanical Engineering, Matrusri Engineering College, Hyderabad, India*

[2]*Assistant Professor, Mechanical Engineering, Matrusri Engineering College, Hyderabad, India*

Abstract – *The present work analyses the vapor compression refrigeration system by using diffuser between compressor and condenser. The refrigerant that leaves diffuser has a higher pressure than the refrigerant entering in it. In the vapour compression method, the function of a compressor is to increase the refrigerant pressure. In the traditional condenser, the pressure drops through the tubes thus. the compressor's power consumption increases. This work is an experimental method to balance the work of the compressor by providing a diffuser at the condenser inlet. The diffuser transforms the high speed available at the discharge from the compressor into the energy of the air. A diffuser is a passive device which recovers the static pressure without any mechanical work input.*

Key Words: **Compressor, Refrigerant, Diffuser, Condenser & refrigeration**

1. INTRODUCTION

The theory of refrigeration deals with the properties of working fluids (refrigerants), and the energy involved in the activity of cooling devices. It provides basic operating theory of all mechanical refrigerators.

In nature, heat transfer occurs from the higher temperature region to lower temperature, without any external devices being needed. The reverse cycle can't happen on its own. Transferring heat from a lower to a higher temperature involves special equipment called refrigerators. The fridge operates according to the reversed Carnot cycle theory.

"Refrigeration is a method of extracting heat from space or a material to reduce and retain temperature below its surroundings." A refrigerator is a typical household appliance consisting of a thermally insulated compartment and a heat pump (mechanical, electronic or chemical) that transfers heat from the interior of the refrigerator to its external surroundings in such a way that the inside of the refrigerator is cold.

Throughout developed countries refrigeration is an important technique of food storage. The lower temperature decreases the bacteria's reproductive rate, so the refrigerator reduces the spoilage rate. A fridge holds a temperature just a few degrees above the freezing point of water. The optimal temperature range for storage of perishable foods is 3 to 5 ° C (37 to 41).

1.1 History

The first food refrigeration system involved using ice. Artificial cooling started in the mid-1750s, and grew in the early 1800s. The first Working vapour- cooling system was developed in 1834. In 1854 the first commercial icemaking unit wa invented. In 1913 the refrigerators were invented for home use. The first self-contained unit was introduced at Frigidaire in 1923.

The introduction of Freon in the 1920s expanded the refrigerator market during the 1930s. Home freezers as separate compartments (larger than necessary just for ice cubes) were introduced in 1940. Frozen food, previously a luxury item, became commonplace. Freezer units are used in households and industry and commerce.

Commercial refrigerator and freezer units were in use for almost 40 years before the common home models. Most households use the freezer-on top and refrigerator-on-bottom style, which has been the basic style since the 1940s.

A vapour compression cycle is used in most household refrigerators, refrigerators-freezers and freezers. Newer refrigerators may include automatic defrosting, chilled water and ice from a dispenser in the door. Disposal of discarded refrigerators is regulated, often mandating the removal of doors. Children playing hide-and-seek have been asphyxiated while hiding inside discarded refrigerators, particularly older models with latching doors. Domestic refrigerators and freezers for food storage are made in a range of sizes. Among the smallest is a 4L Peltier refrigerator advertised as being able to hold 6 cans of beer. A large domestic refrigerator stands as tall as a person and maybe about l m wide with a capacity of 600 L. Refrigerators and freezers may be free-standing, or built into a kitchen.

The refrigerators allow the modern family to keep food fresh for longer than before. Freezers allow people to buy food in bulk and eat it at leisure, and bulk purchases save money.

- Before mechanical refrigeration systems were introduced, people cooled their food with ice and snow, either found locally or brought down from the mountains.
- The first cellars were holes, dug into the ground and lined with wood or straw and packed with snow This was the only means of refrigeration for most of history.

- Cool streams and springs wree used to refrigerate long time ago.
- At warm weather, meat and fish is preserved by salting or smoking
- William Cullen demonstrated first known artificial refrigeration at the University of Glasgow in 1748.
- In 1805, the first refrigeration system was designed by the American inventor Oliver Evans.
- In 1834 Jacob Perkins designed the first practical refrigerating unit.

1.2 Methods of Refrigeration

The refrigeration effect may be produced by bringing the substance to be cooled in direct or indirect contact with a cooling medium such as ice.

The common methods of refrigeration are

- Ice refrigeration
- Dry Ice refrigeration
- Air expansion refrigeration
- Evaporative refrigeration
- Gas throttling refrigeration
- Steam jet refrigeration
- Liquid gas refrigeration
- Vapour compression refrigeration

1.3 Vapour compression refrigeration

The vapor compression cooling system is most widely used for cooling. In this method, the refrigerant changes phase, and such a refrigerant will generate a greater refrigeration effect.

The vapor used as a coolant condenses during the process of heat rejection and evaporates during the process of heat addition (refrigeration). These refrigerants work between liquid (temperature of the condensate) and vapor (temperature of evaporation) conditions. Ammonia, carbon dioxide, sulfur dioxide, Freon group, etc., are the coolants used in this system.

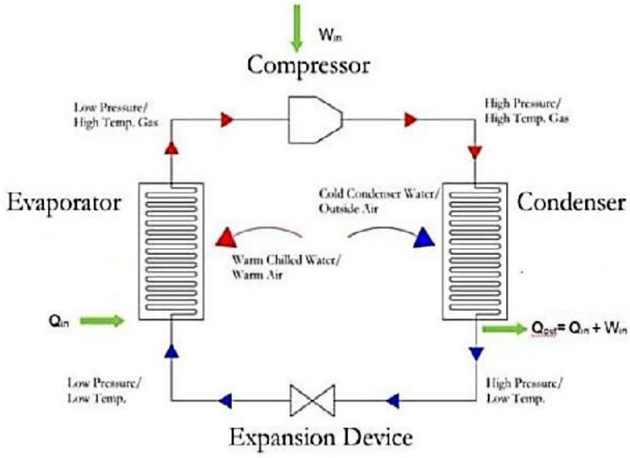

Fig -1: Vapour Compressor Cycle

1.4 Refrigeration Equipment

A typical cooling system is made up of many basic components such as compressors, condensers, expansion devices and evaporators including other devices like sensors, filters, driers, oil separators etc. For the refrigeration device to work effectively, there must be a good match between the various components.

Small capacity refrigeration systems such as refrigerators, room and package air conditioners water coolers are available as complete systems

In this case, the supplier designs or chooses the components of the system itself, assembles them at the factory, checks them for performance and then sells the whole system as a package.

Until assessing the balanced performance of the entire system it is important to evaluate the design and performance characteristics of the individual components. Although most components are common off - the shelf items, components such as evaporators may be order based

2. LITERATURE SURVEY

[1] Ponna Sasikumar1, Dr. Smt. G.Prasanthi “COP Improvement of VCR System (R-600a) by using Diffuser as a Secondary Compressor and varying the Condenser Fins Space” International Journal of Advanced Engineering Research and Technology (IJAERT) Volume 5 Issue 11. The principle of diffusers effect on the VCR system is primarily used to boost the system's COP by the use of Eco-friendly R-600a refrigerant. The research describes the effect of diffuser and condenser on VCR Device output with reduced fins spacing.

The system's COP can be improved either by reducing the compressor's work input, or by increasing the cooling effect.

The VCR machine compressor aims to raise the refrigerant pressure, but refrigerant leaves the compressor at high speed The standard cooling process has significant problems such as high work requirements for the compressors. The diffuser therefore represents a potential solution to the current problem. The diffuser is used to transform the kinetic energy available at the compressor outlet into pressure energy, which results in reduced compressor work With the system's diffuser COP rises. The effect of refrigeration increases with the subcooling. Subcooling occurs by the condenser by strong heat-rejection.

By having more fins in the condenser and also by using the high thermal conductivity material for the fins and condenser coil, high heat rejection is possible.

Thus, brass fins with a gap of 7 mm fins and copper coils in the condenser are used. With the impact of high heat-rejection through the condenser, COP is increased. The combined effect of diffuser and condenser with a 7 mm fins space decreases power consumption and increases COP.

[2] Adityaswaroop1 , S.C. Roy "To Improve COP of a Refrigerator using Diffuser" International journal of advance research in science and engineering vol.no. 6.

The purpose of this project is to demonstrate that by installing a diffuser between the condenser and the evaporator, the COP of the vapor compression refrigeration system can be increased.

Refrigerant R134a has been completed and their results have been registered. Results from the refrigerant vapor compression set-up (at the Heat Engine Laboratory, BIT Sindri) were taken where variables such as compressor suction strength, compressor delivery speed, evaporator and condenser temperature are noted down and refrigerator COP is measured.

Experimental research on vapor compression cooling system using, the diffuser of increases cross-section area profile was developed, manufactured and integrated into their VCRs unit. The chosen diffuser size was at a divergence angle of 15o.

By using diffuser power consumption is lower for the same cooling effect so efficiency is improved. Owing to increased heat transfer the evaporator size can also be reduced.

And so, the evaporator prices will reduce. Pressure and temperature parameters were measured. After the outcome study, authors found that by using traditional VCRs with a diffuser, the COP was improved from 1.877 to 2.07.

[3] Ramesh.S1, Prakash. E2, Sasikumar. R3 , Shajakhan. B4 Jeevanantham.S5 "Increasing COP of a Refrigerator using Diffuser". International Research Journal of Engineering and Technology (IRJET). Vol.no. 03.

The purpose of this project is to provide proof of concept that by installing the diffuser between the condenser and the evaporator, the output of a refrigerator would increase.
They are looking at ways to save energy in this space by improving a product or a process, thus reducing its energy consumption. For this device a adequate cooling effect for minimal electrical input is generated

This technology could support markets such as transportation, biomedical refrigeration, commercial and residential air-conditioning and even the popular drink cooler.

Turning that concept into a mechanical system that is marketable, economically viable will fundamentally change the way we use our resources. The strength of this project is that it uses less energy than traditional fridges.

[4] Rakesh R1, Manjunath H. N2, Krupa R3, Sushanth H. Gowda4, Kiran Aithal S5 "A Study on Enhancing COP in VCR by providing Diffuser in between Condenser and Compressor" NMIT, Bangalore, India.

To boost the output coefficient (COP), the Compressor Work must be reduced and the Refrigerating Effect increased. Experimental analysis of the vapor compression cooling system (VCR) with refrigerant R134A (Tetra Fluro Ethane) was performed and the results were noted.

Results from the vapor compression plant were taken where the variables such as compressor suction pressure, compressor delivery pressure, evaporator and condenser temperature were noted, and performance coefficient (COP) were measured.

The results obtained were validated through simulation with CFD. For CFD simulation modeling and meshing are done in ICEM CFD, analysis in CFX and post results in CFD POST.

[5] N. Upadhyay in his paper to study the effect of Sub-cooling and Diffuser on the Coefficient of Performance of Vapour Compression Refrigeration System,"IJRAME Journal Presents the idea of the effect of subcooling and diffuser on the performance coefficient of the vapor compression cooling system mainly implemented to boost the performance coefficient of the system

To boost the output coefficient, it is important to reduce compressor work and increase the refrigerating effect. The aim of a compressor in a vapor compression system is to increase the pressure of the refrigerant, but the refrigerant leaves the compressor at a comparatively high speed that can cause liquid refrigerant splashing in the condenser, liquid hump and destruction For this reason diffuser can be used as it is important to convert this kinetic energy to pressure energy. By using diffuser, power consumption is lower for the same cooling effect, thus improving efficiency. Owing to even more heat transfer the condenser size may also be reduced. And the condenser expense will be reduced.

[6] D. U. S. W. R. T. Saudagar ISSN: 2278-067X, Volume 1, Issue 11 (July 2012), PP. 67-70 www.ijerd.com refrigeration system with a diffuser at condenser inlet and compressor.

Diffuser is the statics unit. By transferring its kinetic energy, it elevates the pressure of moving air. In vapor compression refrigeration method, the use of diffuser at condenser inlet is one way to prevent the problems of high velocity refrigerant. It smoothly decelerates the incoming refrigerant flow achieving minimum stagnation pressure losses and maximizes static pressure recovery Because of pressure recovery, the compressor has to do less work at the same refrigerating effect.

Therefore, compressor power consumption would be reduced resulting in improved device performance. The use of diffuser would also have an advantage in reducing the impact of starvation on refrigeration vapor compression systems.

3. EXPERIMENTAL SET-UP

3.1. Principle of Operation

The vapor compression process can be studied on a temperature vs Entropy diagram as shown in Fig. The circulating refrigerant enters the compressor as a saturated vapor at point 1 in the diagram. The vapor is compressed internally (i.e. compressed at constant entropy) from point 1 to point 2, and exits the compressor as a superheated vapour. The vapor flows through part of the condenser from point 2 to point 3, which removes the superheat by refrigerating the vapour. The vapor passes through the remainder of the condenser between point 3 and point 4, and is condensed into saturated liquid. The process of condensation takes place at an essentially constant pressure.

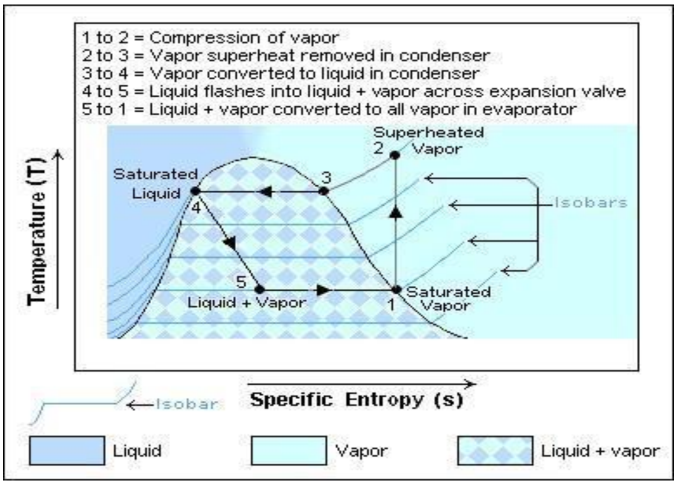

Fig -2: TS Diagram for VCR System

The saturated liquid refrigerant passes through the expansion valve between points 4 and 5, and undergoes an sudden reduction in pressure. This cycle results in the adiabatic flash evaporation and a part of the liquid being auto-refrigerated (typically less than half of the liquid flashes).This throttling process is Isenthalpic Between points 5 and 1 the cold and partially vaporized refrigerant flows in the evaporator through the coil or tubes where it is vaporized by the warm air (from the refrigerated space). The evaporator works at constant pressure, I to complete the thermodynamic process the resulting saturated refrigerant vapor returns to the inlet of the compressor at point 1.

3.2. Diffuser

A diffuser is a mechanical system designed to regulate the properties of a fluid at the entrance to an open thermodynamic system. The diffuser is a passive device which regains its static pressure without any input work Frictional effects may sometimes be important, but usually, they are neglected.

However, the external work transfer is always assumed to be zero. It is also assumed that changes in thermal energy are significantly greater than changes in potential energy and therefore the latter can usually be neglected for analysis. Diffusers may have shape of round, rectangular, or can be as linear slot diffusers

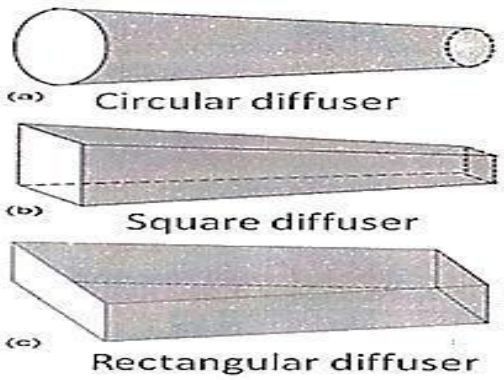

Fig -3: Types of Diffusers

3.3. Difference between nozzle and diffuser

- Nozzle – the device that increases the velocity of fluid at the expense of pressure.
- Diffuser - the device that increases the pressure of a fluid by slowing it down.
- Commonly utilized in jet engines, rockets, spacecraft, and even garden hoses.
- Q = 0 (heat transfer from the fluid to surroundings very small
- W=0 and ΔPE=0

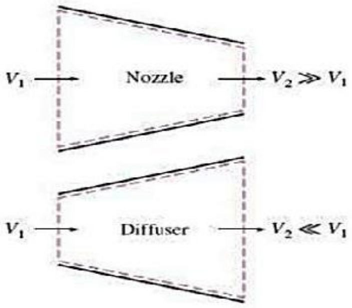

Fig -4: Nozzle and Diffuser

3.4. Types of diffusers based on Mach number

1. Subsonic diffuser.
2. Supersonic diffuser.

The subsonic diffuser is a diffuser whose Mach number of fluids at entrance is less than 1.0

A supersonic diffuser is a diffuser whose Mach number is more than 1.0. Mach number is defined as the ratio of fluid velocity to acoustic velocity.

Mach number= $\frac{c}{a}$; where c is fluid velocity; a is sound velocity

3.5. Refrigerants

A refrigerant is a substance used for heat transfer in a refrigeration system. It picks up the heat (latent heat or sensible heat) from a source at a low temperature and pressure and gives up this heat (latent heat or sensible heat) at a high temperature and pressure.

- Subsonic flow (M<1)
- Sonic flow (M=1)
- Supersonic (M)
- Hypersonic (M >5)

3.6. Specifications of components

The refrigerant used is R-134(a) which is also called tetrafluoroethylene having the boiling point of -26.070C. 70gm. of refrigerant is charged into the system having the following specifications.

Compressor - 1/7 HP hermetically sealed.

Capillary - 0.031" diameter and 7 feet in length.

Condenser - 3/ 16" diameter and 10m length, Air-cooled.

Evaporator - 1/4" diameter.

Storage - 60lts.

The schematic diagram of the vapour compression refrigeration system with a diffuser at condenser inlet is shown at Fig.5. Pressure gauges at the inlet and outlet of the compressor and after diffuser at condenser inlet were used to record the pressures. A calibrated refrigerant flow meter (Rotameter) was used to indicate the refrigerant mass flow rate. A vapour compression refrigeration system instrumented with four temperature sensors to record temperatures.

Flow control valves were used to control refrigerant flow through different diffusers selected during experimentation work

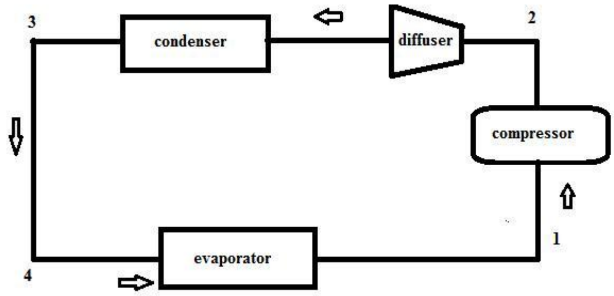

Fig -5: Schematic of VCR with a diffuser at the condenser inlet.

Fig -6: Experimental setup without diffuser

Fig -7: Experimental setup with the diffuser

The vapor compression refrigeration method is based on the vapor compression process. Vapor compression cooling system is used in domestic cooling, food processing, and cold storage, industrial refrigeration system, refrigeration transport, and electronic cooling.

In vapour compression refrigerating system, there are two heat exchangers. One is to absorb the heat which is done by the evaporator and another is to remove the heat absorbed by the refrigerant in the evaporator and the heat of compression added in the compressor and condenses it back to a liquid which is done by the condenser.

Improving the system output is therefore too critical for a higher cooling effect or a reduced power consumption for the same cooling effect. Much effort was made to improve VCR device performance.

This work focuses on heat rejection in the condenser. This is only possible either by providing a fan or by extending the surfaces. The extended surfaces are called fins. The rate of heat rejection in the condenser depends upon the number of fins attached to the condenser. In the present domestic refrigerator galvanized iron steel material fins are used. In this project, mild steel material fins are replaced and galvanized iron steel is used for the condensers.

The performance of the condenser will also help to increase the COP of the system as the increased subcooling increases refrigerating effect. In general, domestic refrigerators have no fans at the condenser and hence extended surfaces like fins play a very vital role in the rejection of heat.

To know the performance characteristics of the vapor compression refrigerating system the temperature and pressure gauges are installed at each entry and exit of the component. Experiments are conducted on condenser having fins.

Various types of devices are often used such as snips to cut the plated fins to the necessary sizes, tube cutter to cut the tubing, and tube bender to bend the copper tube to the appropriate angle. Finally, for the project's necessity the domestic refrigerator is made.

Fig.7. shows the experimental setup of the refrigerator. To know the performance characteristics of the vapour compression refrigeration system the temperature and pressure gauges are installed at each entry and exit of the components. Experiments are conducted on condenser with coil spacing of the condenser on a refrigerator of capacity 60 liters. All the values of pressures and temperatures are tabulated

3.7. Manufacturing of diffuser

The goal of this project is to improve the system's performance coefficient. To boost the output coefficient, it is important to reduce compressor work and increase the refrigerating effect. Changes in the condenser are intended to increase the degree of refrigerant sub-cooling which has an increased refrigerating effect. The aim of a compressor in vapor compression system is to elevate the refrigerant pressure, but the refrigerant leaves the compressor at a comparatively high velocity that can cause the condenser tube to splash liquid refrigerant, liquid hump, and erosion damage to the condenser.

It is important to convert this kinetic energy to pressure energy. Diffuser is a passive system that increases the pressure of the by transferring the kinetic energy available at the inlet.

Since the velocity of the refrigerant in the vapor compression refrigeration device is subsonic, the diffuser can be made with the following measurements.
For a given condenser pipe of bore (mm)
Entrance diameter = 5mm
Exit diameter =6mm
Diffuser length =6cm

$$L = AB = \frac{d_2 - {d_1}/{2}}{tan\theta}$$

The diffuser with the above-calculated dimensions looks like as shown in fig 9.

The diffuser's inlet and outlet diameters were Fixed.

To design the length of diffuser above equation is used

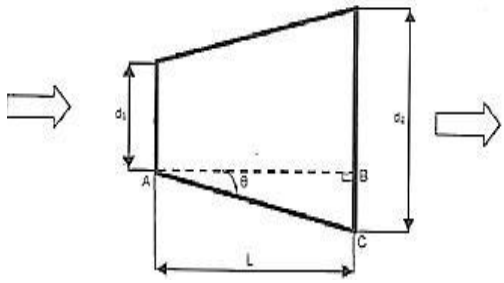

Fig -8: Geometry of diffuser

The relation between length and divergence angle of diffuser is plotted as shown in Fig 8. With an increase in divergence angle of the diffuser, its length reduces for the same inlet and outlet diameters.

Fig -9: Diffuser

A diffuser at the inlet of condenser increases both pressure and temperature of the condenser considerably. Increased pressure in the diffuser helps to reduce the compressor work. The temperature of the condenser can be controlled by the fan motor variable speed drive. The diffuser also reduces the condenser tube vibration as it decelerates the refrigerant smoothly.

Vapour compression system with and without a diffuser is operated with the help of the hand valves (not shown in fig.). Increased pressure can also be utilized to produce more refrigeration effect with the reduced work input to the condenser.

3.8. Advantages

1. An advantage of the present work is that it facilitates static pressure recovery of the refrigerant entering the condenser, thereby increasing the pressure of the refrigerant vapor leaving the diffuser compared to the pressure of refrigerant entering the diffuser.
2. An advantage of the present work is that it increases vapor compression system efficiency.
3. A further advantage of the present work is that it reduces the tube vibration associated with the operation of the condenser.
4. A yet additional advantage of the present work is that it reduces the level of liquid hump inside the condenser.
5. Another advantage of the present work is that it increases the heat transfer rate through the condenser.
6. Arrangement of the diffuser at the inlet of condenser compensates for the compressor Work.
7. The effect of starving can also be reduced.

4. RESULTS & CALCULATIONS

4. 1. Without Diffuser

Mass of water = $1000\ kg$

Cp of water = $4.2\ \frac{KJ}{kg\ C}$

Power consumed = $100\ Watts$

Time = $30\ mins$

1. Initial temperature of water = 29
   After10 mins = 28
   After20 mins = 26
   After30 mins = 24
   Temperature difference = 5
   Refrigeration Effect R.E = $Mass \times C_p \times \Delta T$
   =1000 x 4.2 x 5
   = $21 \times 10^3\ KJ$
   Work Done W.D = $Power \times Time\ Taken$
   =100 x 30 x 60
   = $180 \times 10^3\ KJ$
   Coefficient Of Performance COP = R.E/ W. D
   = $\frac{21 \times 10^3}{180\times10^3}$
   =0.1166
2. Initial temperature of water = 31
   After10 mins = 29
   After20 mins = 26
   After30 mins = 25.5
   Temperature difference = 5.5
   Refrigeration Effect R.E = $Mass \times C_p \times \Delta T$
   =1000 x 4.2 x 5.5
   = $23.1 \times 10^3 KJ$
   Work Done W.D = $Power \times Time\ Taken$
   =100 x 30 x 60
   = $180 \times 10^3 KJ$
   Coefficient Of Performance COP = R.E/ W. D
   = $\frac{23.1 \times 10^3}{180\times10^3}$
   = 0.1283
3. Initial temperature of water = 30
   After10 mins = 28
   After20 mins = 26
   After30 mins = 24
   Temperature difference = 6
   Refrigeration Effect R.E = $Mass \times C_p \times \Delta T$
   =1000 x 4.2 x 6
   = $25.2 \times 10^3 KJ$
   Work Done W.D = $Power \times Time\ Taken$
   =100 x 30 x 60
   = $180 \times 10^3 KJ$
   Coefficient Of Performance COP = R.E/ W. D
   = $\frac{25.2 \times 10^3}{180\times10^3}$
   = 0.14

Table -1: Without diffuser

Temp drop^{0}C	R.E KJ	W.D KJ	COP
5	21 x 10^3	180 x 10^3	0.1166
5.5	23.1 x 10^3	180 x 10^3	0.1283
6	25.2 x 10^3	180 x 10^3	0.1400

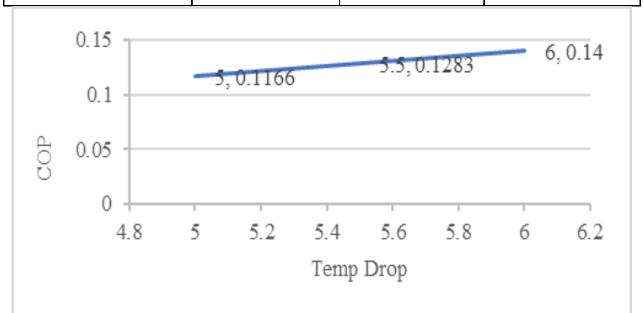

Chart -1: Temp Drop °C Vs COP

4. 2. With Diffuser

Mass of water = 1000Kg

Cp of water = $4.2\frac{KJ}{kg\ C}$

Power consumed = 100 Watts

Time = 30 minutes

1. Initial temperature of water = 23
   After10 mins = 21
   After20 mins = 19
   After30 mins = 18
   Temperature difference = 5

Refrigeration Effect R.E = $Mass \times C_p \times \Delta T$
=1000 x 4.2 x 5
= $21 \times 10^3 KJ$

Work Done W.D = $Power \times Time\ Taken$

= 60 x 30 x 60
= $108 \times 10^3 KJ$
Coefficient Of Performance COP = R.E/ W. D
$= \frac{21 \times 10^3}{108 \times 10^3}$
= 0.1944

2. Initial temperature of water = 31
   After10 mins = 29
   After20 mins = 27
   After30 mins = 25.5
   Temperature difference = 5.5

Refrigeration Effect R.E = $Mass \times C_p \times \Delta T$
=1000 x 4.2 x 5.5
= $23.1 \times 10^3 KJ$
Work Done W.D = $Power \times Time\,Taken$
= 60 x 30 x 60
= $108 \times 10^3 KJ$
Coefficient Of Performance COP = R.E/ W. D
$= \frac{23.1 \times 10^3}{108 \times 10^3}$
= 0.2138

3. Initial temperature of water =33
   After10 mins = 31
   After20 mins = 29
   After30 mins = 27
   Temperature difference = 6

Refrigeration Effect R.E = $Mass \times C_p \times \Delta T$
=1000 x 4.2 x 6
= $25.2 \times 10^3 KJ$
Work Done W.D = $Power \times Time\,Taken$
= 60 x 30 x 60
= $108 \times 10^3 KJ$
Coefficient Of Performance COP = R.E/ W. D
$= \frac{25.2 \times 10^3}{108 \times 10^3}$
= 0.2333

Table.2. With Diffuser

Temp drop^{0}C	R.E KJ	W.D KJ	COP
5	21 x 10^3	108 x 10^3	0.1944
5.5	23.1 x 10^3	108 x 10^3	0.2138
6	25.2 x 10^3	108 x 10^3	0.2333

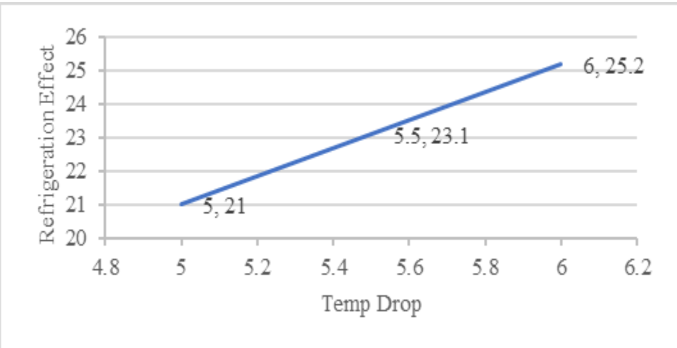

Chart -2: Temp Drop in ^{0}C Vs Refrigeration Effect in KJ (Without Diffuser & With Diffuser)

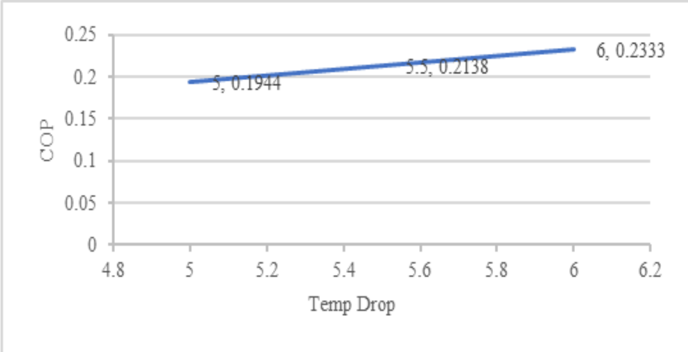

Chart -3: Temp Drop oC Vs COP

Table.3. Without Diffuser

S.No	Temp Drop0C	COP
1	5	0.1166
2	5.5	0.1283
3	6	0.1400

Average cop= $\frac{0.1166+0.1283+0.14}{3} = 0.1283$

Work done = 100 x 30 x 60 = $180 \times 10^3 KJ$

Table.4. With Diffuser

S.No	Temp Drop0C	COP
1	5	0.1944
2	5.5	0.2138
3	6	0.2333

Average cop= $\frac{0.1944+0.2138+0.2333}{3} = 0.2123$

Work done = 60 x 30 x 60 = $108 \times 10^3 KJ$

- COP is increased from 0.1283 to 0.2123
  $= \frac{0.2123 - 0.1283}{0.1283} \times 100 = 65.47\%$
- Work done is reduced from 180 x$10^3 KJ$ to 108 x$10^3 KJ$
  i,e 180 x 10^3 – 108 x 10^3 = 72*10^3 KJ

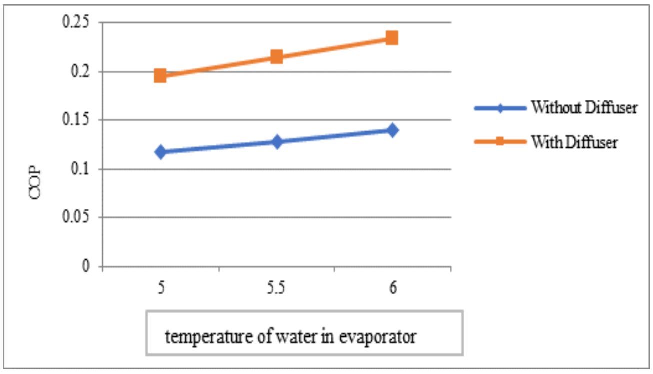

Chart -4: Analysis of C.O.P of VCR with and without Diffuser

4. 3. Results

The vapor compression system performance can be enhanced with the help of the diffuser at the inlet of the condenser. This work produces the following results.

- COP is increased from 0.1283 to 0.2123
  $$\frac{0.2123 - 0.1283}{0.1283} \times 100 = 65.47\%$$
- Work done is reduced from $180*10^3\,KJ$ to $108*10^3\,KJ$

5. CONCLUSIONS

The project that we have done will make an impressive mark in the Refrigeration sector. The research involved in this project has brought down the cost. The project was conceived to achieve the cooling effect faster than the time prescribed. Our project is very compact compared to other traditional refrigerators and is able to conserve energy and therefore cost-effective.

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BIOGRAPHIES

V. Harinath did his M.Tech in Thermal Engineering from JNTUH. Currently he is working as Assistant Professor of the Mechanical Engineering Department in Matrusri Engineering College. He published several papers in National and Inter-National conferences.

A. Kalyan Charan did his M.Tech in Thermal Engineering from JNTUH. Currently he is working as Assistant Professor of the Mechanical Engineering Department in Matrusri Engineering College. He published several papers in National and Inter-National conferences.