DESIGN AND FABRICATION OF VAPOUR COMPRESSION REFRIGERATION SYSTEM BY AUTOMATIC GAS CHARGING

Mr.Rajatkumar V.Pardhi[1] | Mr. Ashish V. Sakhare[2] | Mr. Shubham S. Ambekar[3]
Mr. Shubham.S.Hattimare[4] | Mrs. Tejaswini R. Bawankar[5] | Prof. Ranjeet Mane[6]
[1](B.E. Student of Mechanical Engg, KDK, Umrer, Maharashtra, India, shubhamhattimare5@gmail.com)
[2](B.E. Student of Mechanical Engg, KDK, Umrer, Maharashtra, India, rajatkumarpardhi@gmail.com)
3(B.E. Student of Mechanical Engg, KDK, Umrer, Maharashtra, India, ashishsakhare1996@gmail.com)
4(B.E. Student of Mechanical Engg, KDK, Umrer, Maharashtra, India, shubhamambekar111@gmail.com)
5(B.E. Student of Mechanical Engg, KDK, Umrer, Maharashtra, India, Tejaswini52kar@gmail.com)
6(B.E. Student of Mechanical Engg, KDK, Umrer, Maharashtra, India, ranjeetmn04@gmail.com)

Abstract*—This report presents a study on development and analysis of double effect condensing unit vapor compression refrigeration system (DECU VCR system). The system is composed by two refrigeration cycles working with R134a. Tests under a wide range operating temperature interval conditions were carried out on the developed system. Experimental data was generated to observe the performance of the basic VCR system and DECU VCR system for an important parameters such as condensation (35 to 55°C) and evaporation temperatures (-5 to 15°C). Performance evaluation of the system was characterized in terms of cooling capacity and coefficient of performance (COP). In the present study, both COP and refrigerating effect of the developed system have been found, in general, to be greater than the corresponding basic VCR system values, but the degree of enhancement varies depending on the test conditions. Additionally, by using dedicated sub-cooling cycle, up to 11 and 11.7 % performance improvement ratio of VCR system are observed at evaporation temperature of 15 oC and condensation temperature of 35 oC respectively. It can be concluded that the use of dedicated sub cooling cycle in VCR system is most efficient and suitable for the betterment of thermal system performance.*

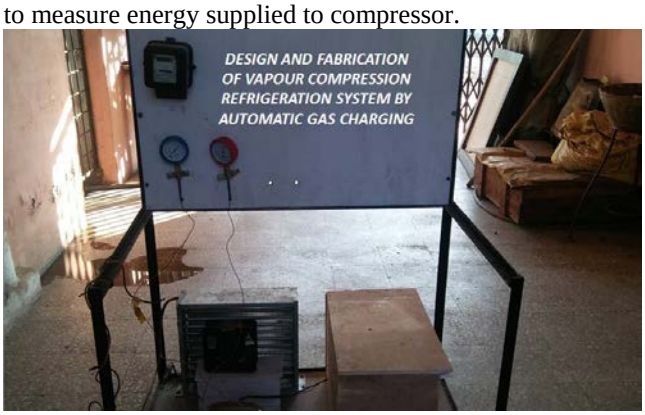
Keywords— Evaporator; Condenser; Compressor; Capillary; Gas Charging Unit; Design and Analysis; Efficient Way; EcoFriendly; Zero Ozone Layer Deflection

1. INTRODUCTION

A vapor compression refrigeration system is an improved type of air refrigeration system in which a suitable working system, termed as refrigerant, is used. It condenses and evaporates at temperatures and pressures close to the atmospheric condition. The refrigerants, usually, used for this purpose are ammonia, carbon dioxide and sulphur dioxide. The refrigerant used, does not leave the system, but is circulated throughout the system alternately condensing and evaporating. In evaporating, the refrigerant absorbs its latent heat from the brine (salt water) which is used for circulating it around the cold chamber. While condensing, it gives out its latent heat to the circulating water of the cooler.

2. CONSTRUCTION

Vapor compression refrigeration test rig consists of a hermetically sealed compressor, air cooled condenser, capillary tube and thermostatic expansion valve. Only one of the two throttling devices should be used at a time. By using shut of valves, one of the throttling devices can be isolated, keeping only one in use and an evaporator. The evaporator cools the water in a calorimeter. A heater is provided at the bottom of calorimeter, whose output can be varied by a dimmer stat. Separate pressure gauges are provided to measure condenser and evaporator pressure. Five suitable thermometers are provided to measure temperatures at various locations. Energy meter is provided to measure energy supplied to compressor.



3. WORKING OF EACH COMPONENT

- Compressor: The low pressure and temperature vapor refrigerant from evaporator is drawn into the compressor through the inlet or suction valve, where it is compressed to a high pressure and temperature. This high pressure and temperature vapor refrigerant is discharged into the condenser through the delivery or discharge valve.
- Condenser: The condenser or cooler consist of coils of pipe in which the high pressure and temperature vapor refrigerant is cooled and condensed. The refrigerant, while passing through the condenser, gives up its latent heat to the surrounding condensing medium which is normally air or water.

● Receiver: The condensed liquid refrigerant from condenser is stored in a vessel known as receiver from where it is supplied to the evaporator through the expansion valve or refrigerant control valve.
● Expansion Valve: It is also called throttle valve or refrigerant control valve. The function of the expansion valve is to allow the liquid refrigerant under high pressure and temperature to pass at a controlled rate after reducing its pressure and temperature. Some of the liquid refrigerant evaporates as it passes through the expansion valve, but the greater portion is vaporized in the evaporator at the low pressure and temperature.
● Evaporator: An evaporator consists of coils of pipe in which the liquid vapor refrigerant at low pressure and temperature is evaporated and changed into vapor refrigerant at low pressure and temperature. In evaporating, the liquid vapor refrigerant absorbs its latent heat of vaporization from the medium which is to be cooled.

4. How to fill the gas charging in VCRs

- After assembling of all components connect 2 way valves to process line.
- Attach charging line to other end of two way valve.
- Connect vacuum pump to charging line.
- Keep compressor off until full vacuuming.
- Check the vacuum pressure 30 psi
- During vacuuming detect leakages with help of soap bubbles.
- Stop vacuuming when vacuum pressure reaches 30 psi and also shut off two way valve.
- Now connect 134a gas cylinder to charging line.

5. Observation Table

Sr. No.	Description	Symbol	Reading
1.	Condenser pressure	Pc	5.9 bar
2.	Evaporator pressure	Pe	5.8 bar
3.	Condenser inlet temperature	Tci	35.8 0C
4.	Condenser outlet temperature	Tco	23.1 0C
5.	Evaporator inlet temperature	Tei	- 0.7 0C
6.	Evaporator outlet temperature	Teo	17.9 0C
7.	Time for 10 revolution of energy meter of compressor	Tc	56 sec
8.	Temperature of water	Tw	8 0C

6. Calculation

$$\text{Carnot COP} = \frac{T(\text{low})}{T(\text{high}) - T(\text{low})}$$

$$T(\text{low}) = -0.7\ 0C = 272.3\ K$$

$$T(\text{high}) = 35.8\ 0C = 308.8\ K$$

$$= \frac{272.7}{308.8 - 272.7}$$

$$\text{Carnot COP} = 7.55$$

7. Specification and Dimension

Components	Specification	Dimension
Evaporator (240lit)	-	*16*10*9*
Compressor (240lit)	*220V,50Hz*	-
Condenser	-	*12*13*2*
Capillary	-	*0.5mm and 0.36mm*

8. Application

- Commercial refrigeration(For Laboratory purposes)
- Objective
- To understand V.C.R. Cycle on P-h diagram.
- To understand refrigerating effect, Compressor work and C.O.P from P-H diagram.
- To understand C.O.P. based on Carnot cycle.

9. Conclusion

- To maintain the higher refrigerant effect.
- It gives accurate temp and pressure of compressor.
- It automatically refill the leakage within tube.

10. Acknowledgement

Though perseverance and enthusiasm combined with effort in the right direction can bring forth the thing called success, but the realization of the harsh reality that the path towards the success is full of myriads, temptations impediments and pitfalls often Proves to be disheartening in such situation.

It is able guidance of knowledgeable person that steers one through difficulties and help them to achieve success.

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