Literature Review for Enhancement of COP of VCC Refrigeration System by using Diffuser

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Abstract— In this paper different literature about the experimental analysis of vapor compression refrigeration system by using the diffuser at inlet of condenser are studied. Coefficient of performance can be increased by reducing compressor work or by increasing refrigeration effect. A diffuser after compressor for a vapor compression system helps to reduce compressor work. The diffuser accepts a compressed liquid refrigerant from a compressor of a refrigeration system. The refrigerant coming out of the diffuser has higher-pressure level than that of refrigerant entering the diffuser. In the condenser, there is a drop in pressure across the tubes thereby increasing the power consumption of the compressor. This paper is a theoretical study about how diffuser will help to reduce the compressor work. Diffuser is the static device which converts the high velocity of liquid refrigerant coming out from the compressor into the pressure energy. Diffuser recovers the pressure without any work input. Refrigerant from the compressor discharge enters the diffuser and increases its pressure considerably.
Keywords: VCC, Diffuser, Condenser, Compressor

I. INTRODUCTION

Refrigeration process is the removal of heat from a space at a temperature lower than the surrounding temperature. The Coefficient of Performance, which is the ratio of refrigeration effect produced at the heat absorption section to the work input by the compressor. COP can be enhanced either by decreasing the work input of compressor or by increasing the refrigeration effect.

In this paper, different researches are studied and the conclusion were made. Diffuser is installed in between compressor and condenser. In VCR system, condenser is used to remove heat from high pressure vapour refrigerant and converts it into high pressure liquid form. The condensers used for domestic application are air cooled. Heat is transferred from the refrigerant to the cooling fluid. Liquid refrigerant with high pressure flows through an expansion device to obtain low pressure refrigerant. Low pressure refrigerant flows through the evaporator. Liquid refrigerant in the evaporator absorbs latent heat of surrounding and gets converted into vapour refrigerant which returns to compressor. In this cycle, the vapor refrigerant leaves the compressor with very high velocity. This high velocity refrigerant directly strikes the walls of condenser which harmful to the system. Due to this vibration, pitting or erosion can occur. It results in undesirable splashing of refrigerant in the condenser coil. This is called as “liquid hump”. Liquid hump is the process in which an increase in the level of the condensed refrigerant liquid in the middle section of the condenser as compared to that of at the ends of the condenser.

II. LITERATURE REVIEW

Saboor et al. [1] developed a new configuration of the ejector-vapour compression refrigeration cycle, which used an internal heat exchanger and intercooler to enhance the performance of the cycle. Results obtained showed that there will be increase of 8.6% and 8.15% in coefficient of performance and second law efficiency values respectively of the new ejector-vapour compression refrigeration cycle. It will be also found that there will be increase of 21% in the coefficient of performance of the new ejector-vapour compression cycle compare to the conventional vapour compression system.

Selvaraju et al. [2] analyzed an ejector with environment friendly refrigerants. Vapour ejector refrigeration is a heat-operated system utilizing low-grade energy such as solar energy, will be the heat from industrial processes, etc., and it could satisfactorily be operated at generator temperature as low as 650°C. It is observed that among the working fluids selected, R134a given a better performance in comparison with other refrigerants.

Akintunde [4] obtained the validation of a design model for vapour compression refrigeration system developed by Akintunde [5]. This model will be used to design a vapour compression refrigeration system. The experimental set-up will be made up of a compressor-reciprocating type, 0.746 kW capacities, using R134a as working fluid, with cylinder stroke volume of 32.7 cm2, evaporator and condenser, bare coil tube-in-tube serpentine copper coil. The analysis showed that the model results will be comparable to the actual system from both quantitative and qualitative points of view. Under the same operational conditions, maximum absolute deviations of the variable parameters – mass flow rate, coefficient of performance and circulating water temperature will be within the range of 16%.

Jianlin Yu, Hua Zhao, Yanzhong Li [6] Presented a novel auto cascade refrigeration cycle (NARC) with an ejector. In the NARC, the ejector is used to recover some available work to increase the compressor suction pressure. The NARC enables the compressor to operate at lower pressure ratio, which in turn improves the cycle performance.

Yinhai Zhu and Peixue Jiang [7] developed a refrigeration system which combines a basic vapor compression refrigeration cycle with an ejector cooling cycle. The ejector cooling cycle is driven by the will be the heat from the condenser in the vapor compression refrigeration cycle. The additional cooling capacity from the ejector cycle is directly input into the evaporator of the vapor compression refrigeration cycle the system analysis shows that this refrigeration system can effectively improve the COP by the ejector cycle with the refrigerant which has high compressor discharge temperature.

Khairul Habib [8] presented the results of an investigation on the efficacy of hybrid compression process for refrigerant HFC R134a in cooling applications. The conventional mechanical compression is supplemented by thermal compression using a string of adsorption compressors. It is shown that almost 40% energy saving is realizable by carrying out a part of the compression in a thermal compressor compared to the case when the entire compression is carried out in a single -stage mechanical compressor. The hybrid compression is feasible even when low grade heat is available. Some performance indicators are defined and evaluated for various configurations.

Abu Zour et al [9] analysed a complex system in which the solar power will be used to increase the efficiency of a traditional vapor compression machine by subtracting heat from the condenser. By means of a transient analysis, performed with a reference building and with climate data corresponding to four different system locations worldwide, the year -round performance of such a system in a space cooling application is estimated in terms of energy balance and savings on power costs with respect to the traditional solutions.

A. Selvaraju and A. Mani [10] investigate the experimental analysis of the performance of a vapor ejector refrigeration system. The system uses R134a as working fluid and has a rated cooling capacity of 0.5 kW. The influence of generator, evaporator and condenser temperatures on the system performance is studied. For a given ejector configuration, there exists an optimum temperature of primary vapor at a particular condenser and evaporating temperatures, which yields maximum entrainment ratio and COP.

XiaoliHao, Cangzhou Zhu [12] described use of direct evaporative coolers to improve the energy efficiency of air -cooled condenser. This evaporative cooler is installed in front of air-cooled condenser to pre-cool outdoor air before entering the condenser. Results will be predicted that the use of the evaporative cooler results in an increase in the refrigeration effect.

Poona Sasikumar, Dr. smt. G. Prasanthi [13] constructed the VCRS with diffuser at condenser inlet and also, they used a varying condenser to improve the COP of system. Refrigerant used by them is R600. They come to the conclusion that power consumption was decreased by 14.29% and COP improved by 14.34%.

R. T. Saudagar, Dr. U. S. Wankhede [14] carried out a study on VCRS with diffuser at condenser inlet. They studied different types of modifications in VCRS i.e. modification in various components. They conclude their study as high velocity of refrigerant could damage the system and liquid hump would create. So, the diffuser which converts the KE into pressure energy can be used to avoid this effect.

Amit p. Kashyap, Sandeep Patel, Akash Pandey [15] studied the performance of VCRS with diffuser at compressor outlet. In their study refrigerant was R134a. They explained different safety properties of refrigerants such as GWP, ODP, TEWI, toxicity. They state that the size of condenser can be reduced by using diffuser. The length of diffuser varies inversely with divergence angle.

Rakesh R., Manjunath H. N., Krupa R., Sushanth H. Gowda, Kiran Aithal S. [16] study the COP enhancement in VCRS by installing diffuser in between compressor and condenser. They perform an experimental study of Diffuser in between compressor and condenser and validated the results through CFD simulation. They came to the conclusion that COP enhanced by 33%.

Ijas Ahmed, Vikrantdh T. S., Robinson T., Saket Sharma [17] designed diffusers with different dimensions to install it in VCRS. They used two refrigerants i.e. R134a and R600. Experimental tests were carried out for both the refrigerants and the results were recorded. They recorded the results as 5.82% improvement in COP using R134a and 17.32% increase in COP using R600.

Adityaswaroop, S. C. Roy [18] carried out an experimental analysis of refrigerator using diffuser. In their paper they gave the information about VCRS components, principle of VCRS and the experimental set up. Results were recorded and according to the readings taken they prove that COP of VCRS is increases by adding diffuser to the system.

Nurul seraj, Dr. S. C. Roy [19] constructed the experimental set up for the evaluation of COP by using diffuser at inlet of condenser. In their study they focused on the manufacturing of diffuser and examining COP with and without diffuser. They found 14.48% increase in COP.

Amit Prakash [20] studied the combine effect of sub-cooling and diffuser on VCRS. He came to the conclusion that sub cooling enhances the refrigeration effect and diffuser helps to reduce compressor work.

Simhadri Kambala, Ibrahim Mohammad [21] made a review of research papers on utilization of two phase ejectors as an expansion device. They state that ejector as an expansion device has advantages like economy, ease in handling two phase flow without damage and environment friendly device.

III. CONCLUSION

After studying different literature published on the diffuser used after compressor in conventional refrigeration cycle, it is concluded that the velocity of vaporized refrigerant is converted into pressure energy. Some part of required pressure increases in diffuser so compressor work is decreases or power consumption is decreases. As COP is the ratio of refrigeration effect to work input, performance or COP increases. This study helps us to know that when diffuser is added to VCRS, power consumption or compressor work is reduced and COP is enhanced.

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