

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 6, Special Issue 11, May 2017

A Review of Different Types of Combine Cooling System

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ABSTRACT: The energy required to drive the various human comfort devices like refrigerator, air conditioner need lot amount power consumption. In this paper the review of the various combined cooling system is carried out in order to develop the proposed study on refrigerator cum air cooler. The power consumption requirement of these devices is high. The refrigerator is devices which generally used for storing the foods and does mean to used it continuously. The combination of refrigerator with air cooler having great advantage for saving electricity consumption and carried out purpose of human comfort and food storage.

KEYWORDS: Refrigerator, Air Conditioner, Electricity Consumption, Human Comfort

I. INTRODUCTION

Cooling systems like air conditioning, Refrigerator, Air Coolers, Water Cooler systems are high electric power consumption's; these systems also have huge impacts on the ecosystem. A proper use or choice with an energy saving plan should be considered in order to make the development of ecosystem sustainable so that a harmony between people and environment could be formed. The best innovative work has done in 20th century was refrigeration where Refrigerator recognized and developed in earlier of 20th century and Air Conditioner is lately in that of 20th century[1]

In India, during summer season the temperature increases upto about range of 45°C to 50°C. During this season there is increase in demand of cooling equipment's such as air coolers, air conditioner etc. If we talk about traditional air coolers, these coolers have very high demand in India because they are cheap and affordable in every aspect and most of the Indian population is belongs to the middle class and thus they can afford these traditional coolers. But these coolers too have disadvantages such as they consumes large amount of water i.e. about 45 to 50 litres of water every day. And also we know that middle class population of India is about 267 million. Although if we consider 250 million of population uses about 50 litres of water every day in their cooler, they consume 12500 million litres of water only in summer season which is very high amount. Also these coolers consumes large amount of wood wool, which is obtained by cutting large amount of trees and trees are the essential parameter which is used for reducing global warming. In this research work study is carried out on the literature study presented on the refrigeration and air cooling combine system.

II. CONSTRUCTION AND WORKING OF VCRS

Vapor-Compression Refrigeration or vapor-compression refrigeration system (VCRS), in which the refrigerant undergoes phase changes, is one of the many refrigeration cycles and is the most widely used method for air-conditioning of buildings and automobiles. It is also used in domestic and commercial refrigerators, large-scale warehouses for chilled or frozen storage of foods and meats, refrigerated trucks and railroad cars, and a host of other commercial and industrial services. Oil refineries, petrochemical and chemical processing plants, and natural gas processing plants are among the many types of industrial plants that often utilize large vapor-compression refrigeration systems.

Refrigeration may be defined as lowering the temperature of an enclosed space by removing heat from that space and transferring it elsewhere. A device that performs this function may also be called an air conditioner, refrigerator, air source heat pump, geothermal heat pump or chiller (heat pump).

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The vapour-compression refrigeration cycle has four components: evaporator, compressor, condenser, and expansion (or throttle) valve. The most widely used refrigeration cycle is the vapour-compression refrigeration cycle. In an ideal vapour-compression refrigeration cycle, the refrigerant enters the compressor as a saturated vapour and is cooled to the saturated liquid state in the condenser. It is then throttled to the evaporator pressure and vaporizes as it absorbs heat from the refrigerated space.

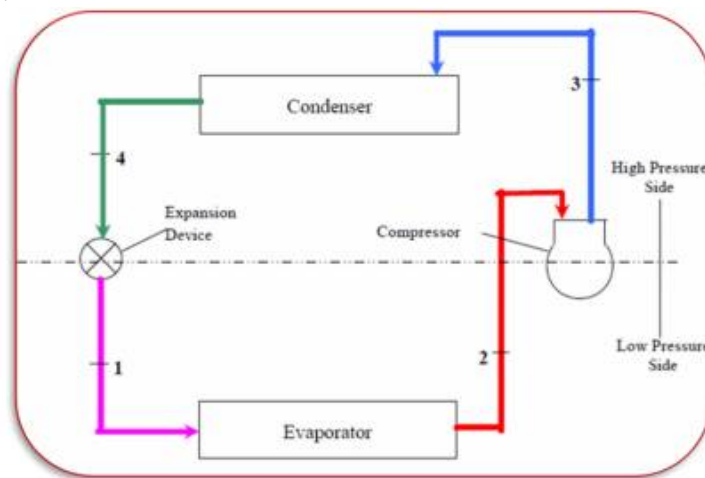


Fig.1.1 Working of VCRC

The ideal vapour-compression cycle consists of four processes. Ideal Vapour-Compression Refrigeration Cycle Process.

1-2 Constant pressure heat addition in the evaporator

2-3 Isentropic compression

3-4 Constant pressure heat rejection in the condenser

4-1 Throttling in an expansion valve

The vapor compression refrigeration cycle described in the previous section is widely used for a variety of cooling purposes, such as household refrigerators and freezers; home, industrial and commercial air conditioners; and automobile air conditioners. The locations of the components of a vapor compression cycle in a household refrigerator/freezer are shown in the diagram at the right. The evaporator coils are located in the freezer compartment, so low temperature heat is removed from that freezer compartment, keeping it as the coldest location in the refrigerator freezer. The compressor is shown at the bottom on the back of the refrigerator. It sends its compressed, high temperature vapor output through the condenser coils at the back of the refrigerator, where heat is given off to the air outside the refrigerator. Finally, the capillary coil shown at the upper part of the refrigerator back serves as the expansion valve, that cools the liquid leaving the condenser as its pressure is reduced, providing the input flow to the evaporator.

III. LITERATURE SURVEY

L.O.S. Buzelina, S. C. Amicoa, [1] et.al discuss on an alternative solution to reduce energy consumption in industrial refrigeration systems is proposed and introduced. A typical industrial refrigeration system was conceived, built and modified in the laboratory, receiving a novel power law control system, which utilizes a frequency inverter. The operation and energy consumption of the system operating either with the new control system or with the traditional on-off control were compared to realistically quantify the obtained gains. In this manner, the measured temperature data acquired from several points of both systems and the energy consumption in kW h during a 24 h experimental run period are compared. From the experiment he concluded that the closed-loop power law controlled system shows a much smaller variation of the cold chamber internal temperature and electrical energy consumption economy of 35.24% in comparison with the traditional on-off system, under the same operating conditions.

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U. V. Kongre, M. B. Salunkhe, [2] et.al discussed about the design contributions for evaporator, condenser and capillary tube. Based on conventional methodologies the design calculations were done. Further discusses the designed methods which are suitable for combined conventional air-conditioning and dispenser.

Tassou and Qureshi, [3] et.al showed that the use of a frequency inverter in refrigeration for compressor speed control may cause harmonic distortions in the systems and a power factor reduction which, in turn, increases energy consumption. However, benefits such as a better temperature control and a lower response time for abrupt thermal load changes were also mentioned.

M. Fande, A. M. Andhare [4] et.al discuss on the experimental investigation of the effect of HFC refrigerant R134a on a vapour compression refrigeration system by using two expansion devices with the conservation of energy by waste heat recovery system. He used two different evaporators for air cooling and water chilling respectively and a water cooled condenser is used to produce hot water. The existing system can be easily retrofitted as a waste heat recovery device and the existing R22 refrigerant can be replaced by R134a with minor modifications. After experimentation the maximum temperature achieved in water tank with 50 litre of water is 45 C during 3 to 4 working hour. After that performance of system decreases so it needs a regular use of that hot water which can be further used for household and industrial purposes.

Prof. S. K Gupta [5] et.al has discussed about the attempt he made to merge Domestic Refrigerator and Air conditioner into a combined system such that an ordinary man can have a sound sleep which automatically increases his working productivity for the next day. To fulfilled it in minimum construction, maintenance and running cost, he made an attempt which is quite useful for domestic purpose so that his ultimate aim of the project that is those who cannot afford an Air Conditioner can have the comfort of Air Conditioner could be completed.

S. A. Nada et.al [6] published a paper on "Performance analysis of proposed hybrid air conditioning humidification-dehumidification system for energy saving and water production in hot and dry climatic region" in which he discussed on The objective behind the proposed system is energy saving and production of fresh water.

J. K. Dabas et.al [7] discuss about his study on the behavior of performance parameters of a simple vapour compression refrigeration system while its working under transient conditions occurred during cooling of a fixed mass of brine from initial room temperature to sub-zero refrigeration temperature. The effects of different lengths of capillary tube over these characteristics have also been examined. It was concluded that Larger capillary tube decreases the tendency of refilling of evaporator but offers less „evaporator temperature“ effective in lower range of refrigeration temperature. Shorter capillary tube ensures higher COP initially but which deteriorates at a faster rate in lower temperature range. Capillary tube length must be optimized for maximum overall average COP of the system for the complete specified cooling job.

Tarang Agarwal et.al [8] discussed in his paper about a cost-effective method to increase the COP and utility of a domestic refrigerator using R-134a refrigerant. In his experiment a cabin was installed on the top of a domestic refrigerator with condenser coils of refrigerator serving as heating coils inside the cabin. Known quantity of water was heated by the condenser coils thereby increasing the overall COP of the refrigerator. Further, the utility was increased since it can serve the purpose of cooking (oven), geysers etc. Besides, the refrigerator may be used as conventional refrigerator by keeping the cabin door open in case of absence of heat sink. He was concluded that one can increase the COP upto 11% just by using a cabin on the top of the refrigerator unit. Further increase in COP is possible; however enhancements will involve higher costs.

M.R. Abdelkader et.al [9] discuss on free cooling techniques can be used to substantially reduce energy costs. During cold weather, the outside ambient temp help in saving energy in refrigeration work. The minimum temperature of the ambient air supply enables free cooling technique to store fresh fruits and vegetables. This technique of energy-efficiency measure can save enough compressor electric power to pay for modulating damper installation costs in approximately one year. Free cooling has a kind of motorized damper that conducts the two flows of internal and external air. When the damper is open it takes the air necessary cooling directly from the exterior, excluding

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compressor operation. It starts the evaporator fan that takes external air if $T_{\text{external}} < T_{\text{internal}}$. A case study has been carried out for 17 Ton cooling load in a storage room and the COP can be reached to the only energy consumption is from the use of evaporative fans.

Raman Kumar Singh [10] discuss about the Human comfort conditions deal with the conditions of environment around us, viz. hot and cold. The control of temperature of air around us is done by controlling the output water from the water cooler. He made a novel idea to control air temperature around us by the incorporation of cooling system in a single unit. This unit would be an economic utility at all places to provide comfort conditions to the people. Faster, mightier & smaller is still the keyword for every invention and development he concentrate on the compactness and efficiency of every product. Accordingly he have designed and fabricate an economical and reliable unit known as —Water Cum Room Cooler(Three in one air conditioner).

Dr. U. V. Kongre, et.al [11] discuss about the multifunctional system he was built which gave output hot and cold water with hot and cold air. The paper introduced basic design principles and the test analysis performed in the laboratory also mentioned comfort conditions and suitable coefficient of performance with respect to atmospheric condition, without sacrificing the air conditioning output. The air-conditioner cum water dispenser was manufactured for air, water & air-water cycle combined. The air cycle provides good results with conventional optimum efficiency. The water cycle also predicts better results, but then water cycle alone is not useful. Hence the combine air conditioner cum dispenser by utilizing conventional air-conditioning. The dispenser gives required efficiency in terms of coefficient of performance.

K. Nagalakshmi et.al [12] discuss about the design and performance analysis of refrigeration system using R12 & R134a refrigerants. The purpose he mentioned behind his research is to investigate behaviour of R134a refrigerant. This includes performance and efficiency variations when it replaces R12 in an existing system as well as changes involved in maintaining the system charged.

III. PROPOSED EXPERIMENTAL

Now a day the refrigerator is used in every houses and required lots of power consumption. Generally it is used only for storing the foods and edible. We are proposed the methodology for the developing the combination of refrigerator and air cooler in order to application for lower economy and more efficient. The proposed setup of the research work is shown in figure consisting of the different elements of cooling system.

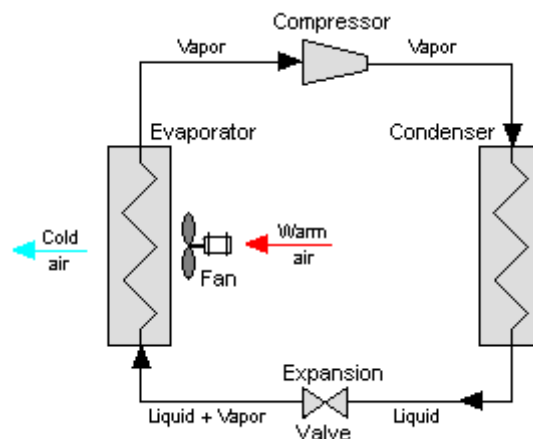


Fig.1.2 Proposed Experimental Setup

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IV. CONCLUSION

The presented research articles broadly concentrated on the working principal of the VCRS and different researches presented over the use of refrigerator as air cooler. The aim of the presented study is to applied for developing the proposed research work.

REFERENCES

- [1] L.O.S. Buzelina, S. C. Amicoa, (2005),Experimental development of an intelligent refrigeration system", International Journal of Refrigeration 28,165-175.
- [2] U. V. Kongre, M. B. Salunkhe, A. A. Pohekar, (2013),Design Methodologies of air-conditioner cum water dispenser", International Journal of scientific research and management (IJSRM) ,Volume1,Issue 1, Pages 18-22.
- [3] S. A. Tassou, T. Q. Qureshi, (1994) Performance of a variable-speed inverter motor drive for refrigeration applications, Compute Control Eng J 5 (4) 193-199.
- [4] M.Fande, A. M. Andhare, (2015),Experimental Investigation and Performance Evaluation of a Three in one Vapour Compression System using Refrigerant R134a", International Journal of Engineering Research & Technology, Volume 4, Issue 05, Pages 1109-1112.
- [5] Prof. S. K. Gupta, (2014),Feasibility Study and Development of Refrigerator cum Air Conditioner", International Journal of scientific and research publication,Volume4,Issue12.
- [6] S. A. Nada, (2015)Performance analysis of proposed hybrid air conditioning humidification-dehumidification system for energy saving and water production in hot and dry climatic region,Energy Conversion and Management, Volume 96, Page No. 208-227.
- [7] J. K. Dabas, A. K. Dodeja, (2011),Performance Characteristics of "Vapour Compression Refrigeration System" Under Real Transient Conditions", International Journal of Advancements in Technology, Vol. 2 No. 4.
- [8] Tarang Agarwal, (2014),Cost-Effective COP Enhancement of a Domestic Air Cooled Refrigerator using R-134a Refrigerant,International Journal of Emerging Technology and Advanced Engineering, Volume4,Issue11.
- [9] M. R. Abdelkader, (2010),Efficiency of Free Cooling Technique in Air Refrigeration System, Jordan Journal of Mechanical and Industrial Engineering,Volume4,Number6,Pages711-724.
- [10] Raman Kumar Singh,(2015),Design and Fabrication in one air conditioning", International Journal of Research in Computer Applications and Robotics, Vol. 3, Issue 6, Pages 8-14.
- [11] Dr.U. V. Kongre,(2013),Testing and Performance Analysis on Air Conditioner cum Water Dispenser", International Journal of Engineering Trends and Technology (IJETT), Volume4, Issue4.