Comparative Study on Cooler cum Air Conditioner Based On VCRS by using Refrigerant R134a

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ABSTRACT

The aim of this paper is to comparatively analyze of Ac cooler by using a refrigerant (R134a) over a Indian traditional cooler and Air Conditioners. In 21st century the world facing problem of electricity and water to overcome this problem worldwide many researches going on. Further cooler uses water so as cooling air, for this application much more quantity of water has been used every year. Also to make this efficient woods product known as "wood wool / khas" have been used which became a major reason of deforestation. The refrigerant R134a absorbs the heat from air and makes the cool air by getting vaporised in evaporator and then the cooled air is sent outward from the opening in the research model with help of fan running on motor and gives the cooling effect. This use of VCRS system with eco -friendly refrigerant reduces the consumption of the water, electricity consumption and tree which is used for making wood wool in conventional cooler. This ultimately reduces the global warming.

Key words: Refrigeration and Air conditioning, Optimized, Deforestation, Ecological Balance, Emphasize, Consumption, Pleasant

1. 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. However it has become the prime necessity in 21st century. In over span of three decades, there is continuously increase in energy demand due to everlasting population increases in India. By this product a normal person could have a sound sleep so that his productivity for the next day increases.

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.

Now if we come on Air conditioner, the cost this equipment is very high it is about 20000Rs to 25000 Rs. if we go for good AC in India. Also the electricity consumption of this air conditioning equipment is also very high. And these equipment produce adverse effect on the environment which ultimately leads to the global warming.

The concept of this project explores the possibility of combining four units So for reducing such huge consumption of water, trees, electricity, which ultimately leads to wealth consumption, this research project includes to provide the cooling effect of air as such like the air conditioners without using water, wood wool and by consumption of low amount electricity. This ultimately leads to reducing the monthly tariff and also having very less effect to the environment.

2. COMPONENTS

I. CONDENSER:

We used air cooled condenser in which the removal of heat is done by air. The size of tube usually ranges from 6mm to 18mm outside diameter, depending upon the size of condenser. The condensers with steel tubes are used in ammonia refrigerating systems. The tubes are usually provided with plate type fins to increase the surface area of heat transfer. The fins spacing is quite wide to reduce dust clogging.

Specification: Height =24 cm , Length = 25.5cm , Width = 4cm Condenser pipe =1cm ,

Fig. 2.1 Air Cooled Condenser

II. COMPRESSOR:

We used Hermetic Sealed Compressors because these types of compressor eliminate the use of crankshaft seal which is necessary in ordinary compressors in order to prevent leakage of refrigerant. The hermetic sealed compressor is widely used for small capacity refrigerating systems such as in domestic refrigerators, home freezers and window air conditioners.

Specification: Inlet pipe = 0.6 cm, 220V / 50Hz, 1PH, thermally protected.

Fig.2.2 Hermetic sealed compressor

III. EVAPORATOR:

An evaporator is a device used to turn the liquid form of a chemical into its gaseous form. Liquid refrigerant at a low temperature passes into evaporator where it extract heat from the product to be cooled. Due to absorption of extract heat liquid refrigerant turns into vapour, and enters in to the compressor. Evaporator is an important component together with other major components in a refrigeration system such as compressor, condenser and expansion device.

Fig. 2.3 Evaporator

IV. 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 vaporizing the evaporator at the low pressure and temperature.

A thermal expansion valve (often abbreviated as TEV, TXV, or TX valve) is a component in refrigeration and air conditioning systems that controls the amount of refrigerant flow into the condenser thereby controlling the superheating at the outlet of the evaporator.

Fig. 2.4 Capillary Tube

V. FAN

The fan shall be well balanced. The blade and blade carriers shall be securely fixed so that they do not get loose in operation. The metallic parts shall be powder coated or suitably protected against corrosion.

Specification: Blade=232mm diameter, Angle=22.5 degree.

VI. MOTOR:

A 3-phase induction motor has two main parts.

A stationary stator and a revolving rotor. The rotor is separated from the stator by a small air gap that ranges from 0.4 mm to 4 mm, depending on the power of the motor.

The stator consists of a steel frame that supports a hollow, cylindrical core made up of stacked laminations. A number of evenly spaced slots, punched out of the internal circumference of the laminations, provide the space for the stator winding. The rotor is also composed of punched laminations. These are carefully stacked to create a series of rotor slots to provide space for the rotor winding. We use two types of rotor windings:

(1) Conventional 3-phase windings made of insulated wire

(2) squirrel-cage windings.

VII. REFRIGERANT

Refrigerant (134-a)

A refrigerant is a fluid in a refrigerating system that by its evaporating takes the heat of the cooling coils and gives up heat by condensing the condenser.

In CFCs and HCFCs present the chlorine content which contribute to the depletion of ozone layer.

- But the alternative refrigerant of CFCs and HCFCs is Hydro fluorocarbon HFCs (R134a, R152a, and R32) as there are no Content of chlorine.

Refrigerant	Molecular wt.	Boiling pt.	Chemical Formula	(ODP)
R134a	102	-26.1^{0}C	C2H2F4	0

Fig. 2.5 Refrigerant (R134a)

3. WORKING

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.

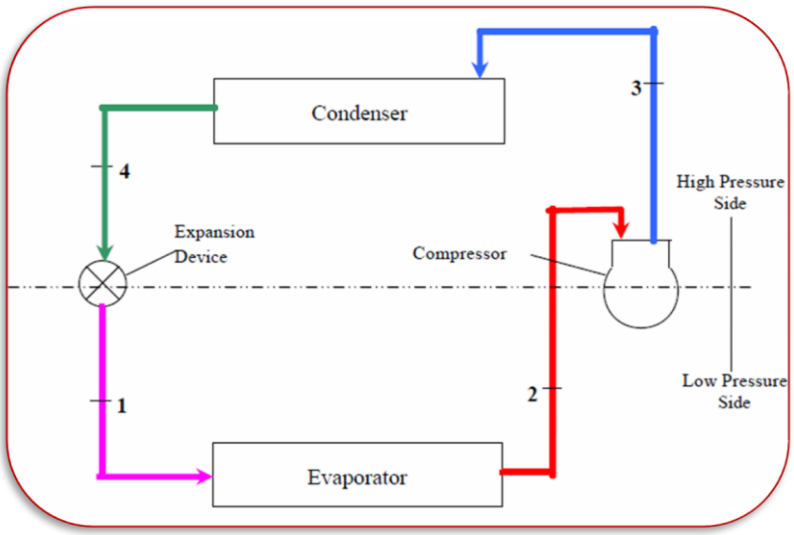

Fig.3.1 Working VCR System

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

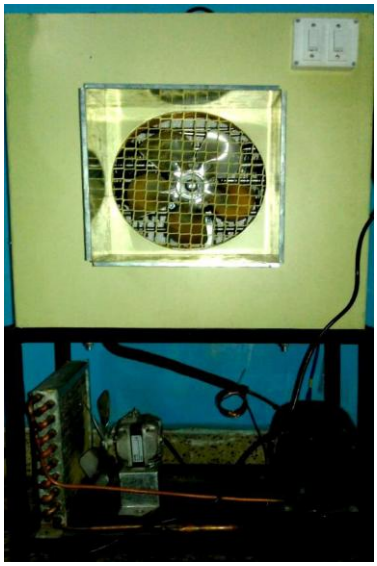

Fig.3.2 VCRS Based Cooler.

7. RESULT

Higher compatibility and portability is achieved which is more efficient than other cooling units. And affordable to all class of people with high performance.

8. CONCLUSION

Environmental groups and governmental agencies have cooperated over the last two decades to bring about reductions in refrigeration and air conditioning systems energy consumption and refrigerant emissions.

R134a refrigerant is non-toxic and does not flare up within the whole range of operational temperatures. This project is very cheap and effective as compared with the conventional cooler and air conditioner system as it based on VCRs system. It has very low power consumption which ultimately increases the COP of the system which increases the cooling effect (refrigeration effect) of the system. It has very low effect on environment as it saves electricity and water. The concept is very cost effective as compared to AC and Very Energy Effective system.

9. REFERENCE

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) Arora & Domkudwar, A course in Refrigeration & Air Conditioning, 7th Edition, Delhi, Dhanpat Rai & Co, 2012
4) Dr. S.C. Kaushik, Mr N.L. Panwar, and Mr V. Reddy Siva, "Thermodynamic analysis and evaluation of heat recovery through a Canopus heat exchanger for vapour compression refrigeration (VCR) system." Journal of Thermal Analysis and Calorimetry, 2011, DOI: 10.1007/s10973-011-2111-7.
5) Domkundwar, Arora, Domkundwar, "Referigeration and Air Conditioning", Dhanpart Rai & Co., Chapter 17.
6) P.K Nag "Heat and Mass Transfer", 3rded. Pvt. Ltd., 2013, pg. 570–580.
7) N.J.Shanland (1989), " Thermo physical properties of 1,1,1,2 –tetra fluoro ethane (R134a)", proceedings of the International Journal of Thermophysics, Netherlands, vol .10, No.3, PP 591-603
8) Pramod Kumar, 2002. Finite Time Thermodynamic Analysis of Refrigeration/ Air Conditioning and Heat Pump Systems, Indian Institute of Technology, Delhi, N D. http://www.sciencedirect.com/science/article/pii/S1290072904001796
9) Electromechanical Energy Conversion", Brown, David, and Hamilton, E. P., MacMill an Publishing Company, 1984.