EXPERIMENTAL ANALYSIS OF YEAR AROUND AIR CONDITIONER

R.Sivash[1], V.Kannan[2]

[1]PG Scholar, [2]Assistant Professor
Mechanical Engineering Department
TRPEC, Trichy, India

Abstract: **Our world climate is partially cold and partially hot. For our convenience we use air conditioner machine in summer season for cooling and room heater in winter season to increase the room temperature (to avoid sweating). While we are using air conditioner machine it takes 1200W and for Room heater it takes 6000W, so it is not possible for our country situation because of scarcity of electrical power. In this project it is planned to modify Vapour Compression System air conditioner machine for dual purpose (i.e.) for thermodynamic cooling and thermo dynamic heating purpose with constant electric power consumption. Reverse Carnot cycle COP will be always greater than 1 so it possible to improve the output.**

Keywords: **Vapour compression system, R-22 Refrigerant, 4 way valve, Electro magnetic trigger, Air draft fin, Properties of refrigerant, Mass of refrigerant, COP of refrigerant.**

I.INTRODUCTION

The distinctive features of the regional climate is that the summer is hot and wet, while the winter is cold with high humidity, and small temperature difference between day and night, the annual rainfall is great with less sunshine. Due to historical and economic reasons, the region's average residential building has no heating air conditioning, and the general thermodynamic performance of retaining structure is very poor, and indoor thermal environment and living conditions are very bad. Along with the region's economic development and people's better living standards, people have higher requirements for heating air conditioning. For the region, the conventional air conditioning heat and cold source schemes usually set respectively cold sources (refrigerator) and heat source (boiler). Due to the efficiency and environmental pollution problems, air conditioning heat source mode has gradually turned from the boiler to heat pump units with higher efficiency and more environmental protection. Currently, using air-cooled heat pump and ground source, water source heat pump and ground source heat pump for heating in winter and summer air conditioning, due to poor weather conditions in the region, all kinds of problems of the building itself appear, such as high energy consumption of air conditioning and heating, serious waste. The laws and regulations about energy saving of building air conditioning and heating have been enacted and the air conditioning and heating systems energy saving researches focus on the existing evaluation indexes, such as energy-saving reform policy, existing buildings, a variety of air conditioning system for air conditioning and heating, etc. Air conditioning system, as a heat source tower after the new air conditioning system, due to its low temperature heat taken from the high humidity environment and the characteristics of the design, can save energy in hot summer and cold winter region efficiently. As the heat source tower, heat pump air conditioning system is widely used in hot summer and cold winter region, and more and more scholars begin to study this system at home and abroad.

II.DESIGN AND FABRICATION

2.1 Design Calculation

Outdoor (Condenser)

COPPER TUBE

DIMENSION

Outer diameter of the copper tube OD =1cm

Length of the copper tube l =56cm

No of turns n =76

AREA

Area of the copper tube $A = \frac{\pi}{4} d^2$

$= \frac{\pi}{4}(1)^2$

$A = 0.7854 cm^2$

Total area of the copper tube $A_1 = 0.7854 \times 76$

$A_1 = 59.6904 cm^2$

FINS

DIMENSION

Length of the fins l=46cm

Breath of the fins b=7.7cm

Thickness of the fins t=0.025cm

Number of fins n=440

FINS AREA

Area of the fin(with copper tube)A_2=l×b×t

=46×7.7×0.025

A_2=8.855cm^2

Total area of the each fin (without copper tube)=
{Area of the copper tube-Area of the fin(with copper tube)}

=59.6904-8.855

=50.8354cm^2

Total area of the fins (condenser) A=50.8654×440

A=22367.576cm^2

IN DOOR (EVAPORATOR)

COPPER TUBE

DIMENSION

Outer diameter of the copper tube OD =0.8cm

Length of the copper tube l =79cm

No of turns n =34

AREA

Area of the copper tube A =$\frac{\pi}{4}d^2$

=$\frac{\pi}{4}(0.8)^2$

A =0.5024cm^2

Total area of the copper tube A_1=0.7854×34

A_1=17.0816cm^2

FINS

DIMENSION

Length of the fins l=47cm

Breath of the fins b=2.5cm

Thickness of the fins t=0.025cm

Number of fins n=600

FINS AREA

Area of the fin each (with copper tube) A_2=l × b × t

=47×2.5×0.025

A_2=2.64375cm^2

Total area of the each fin (without copper tube) =
{Area of the copper tube-Area of the fin (with copper tube)}

=17.0816-2.6437

=14.4379cm^2

Total area of the fins(evaporator) A=50.8654×600

A=8662.74cm^2

Fig.1 Outdoor Condenser

Fig.2. Indoor Condenser

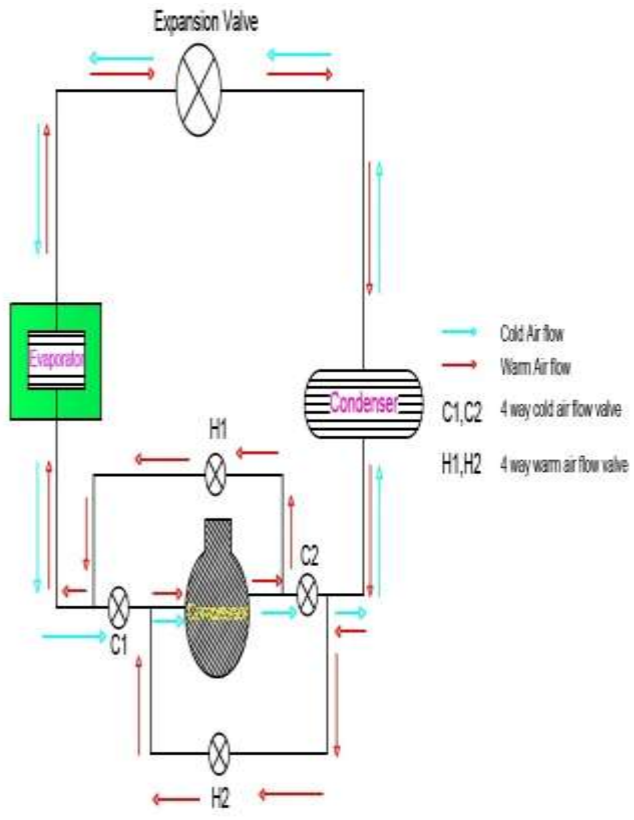
III.Working principle

3.1 Cooling mode

This type of mode C1&C2 valve to be open and H1, H2 valve to be closed. Using type of refrigerants is R22 because high temperature application for this system. Compressor is compressing a refrigerant upto 300 psig near 60°C for High Pressure High Temperature (HPHT) vapor stage. Then condenser is condensing the HPHT vapour into (HPHT) Liquid at same pressure 300 psig. Only temperature to be reduced for 45°C. Then supply to the expansion valve to reduce the pressure of the refrigerant is 70psig.Then evaporator to the (HPHT) Liquid to convert the (LPLT)Vapour of the refrigerant upto 70psig near 15 .Then finally this cycling process is repeated at cooling mode of the system.

3.2 Heating mode

This type of mode only applicable for a below the room temperature of the room. At a heating mode time H1&H2 valve to be open and C1,C2 valve to be closed. When we are starting the system R22 Refrigerant to be compressed to the compressor upto 300psig near 60°C (HPHT) vapor stage. Reversed heat pump working principle similar to the heating mode of operation so Evaporator to be performed a condenser so HPHT vapor to be converted to HPHT Liquid stage at a same 300psig but temperature to be reduced nearly 45°C .Then Expansion valve to be reduced pressure and temperature upto 70psig.Then condenser to be performed a evaporator so LPLT Liquid converted into a LPLT Vapor range of 70psig &15°C in this type of cycling operation will be continuously repeated.



Saturation Temperature In "°c"	Saturation Pressure "bar"	Specific volume (m^3/kg)		Specific enthalpy (KJ/kg)			Specific entropy (KJ/kg)	
		Liquid (v_f)	Vapour (v_g)	Liquid (h_f)	Vapour (h_g)	Latent (h_{fg})	Liquid (s_f)	Vapour (s_g)
-2	4.68317	0.000775	0.0503	42.52	251.14	208.62	0.1675	0.9370
50	19.61380	0.000922	0.0113	112.86	264.05	151.91	0.4003	0.8680

IV PERFORMANCE CALCULATION

$T_1 = T_4$ = -2°c = -2+273 = 271K

$T'_2 = T_3$ = 50°c= 50+273 = 323K

T_3 = 70°c = 70+273 = 343K

h_1= 251.14 KJ/kg

h'_2=264.05 KJ/kg

$s_1=s_2$ = 0.9370 KJ/kg

s'_2= 0.8680 KJ/kg.k

$h_4=h_3$ = 112.86 KJ/kg.k

4.1 Co-efficient of performance (cop)

$s_1=s_2= s'_2+ C_P \ln\frac{T_2}{T'_2}$

$0.9370=0.8680+C_P \ln\frac{343}{323}$

$C_P \ln\frac{343}{323}$ =0.9370-0.8680

$\boldsymbol{C_P}$ **=1.1485KJ/kg.k**

$h_2=h'_2+C_P(T_2-T'_2)$

=264.05+1.1485(343-323)

$\mathbf{h_2 = 287.02KJ/kg}$

$\text{COP}=\frac{h_1-h_{f3}}{h_2-h_1}=\frac{h_1-h_3}{h_2-h_1}=\frac{h_1-h_4}{h_2-h_1}$

$=\frac{251.14-112.86}{287.02-251.14}$

COP=3.85

4.2 Mass of refrigerant

$$\dot{m}= \frac{\text{cooling effect}}{3600\ (h_{2-}\ h_1)}$$

$$= \frac{28000}{3600(287.02-251.14)}$$

ṁ = 0.2168 kg/s-ton

4.3 Compressor power

Compressor power = ṁ (h_2-h_1)

= 0.2168 (287.02 - 251.14)

Compressor power =7.778KW

4.4 Refrigerant capacity

Refrigerant capacity=ṁ (h_1-h_3)

=0.2168(251.14-112.86)

Refrigerant capacity =29.979KW

4.5 Heat removed through condenser

Heat removed through condenser=ṁ (h_2-h_3)

=0.2168(287.02-112.86)

Heat removed through condenser=37.757KJ/sec

Cop = work output/work input

= 3.14641

V CONCLUSION

In this work the different types of air conditioner system was studied and a new model of year around air conditioner system has been designed and optimized along with the material for fabrication.

In phase II, the fabrication work and experimental analysis of the year around air conditioner system will be carried out.

REFERENCES

[1] Application Research on the Closed-Loop Heat-source-Tower Heat Pump Air Conditioning System in Hot-summer and Cold-winter Zone by Jianlin Chenga, Shenhua Zoua, and Shiqiang Chena (International journal on energy engineering, 2015)

[2] An experimental study on performance during reverse cycle defrosting of an air source heat pump with a horizontal three circuit outdoor coilgions. By Song Mengjiea, Xu Xiangguob, Deng Shiminga, Mao Ning International journal on energy engineering, 2014)

[3] Hot Water Making Potential Using of a Conventional Air-Conditioner as an Air-Water Heat Pump by Praitoon Chaiwongsaa and Weerapun Duangthongsuka(International journal on energy engineering,2011)

[4] An open Reversed Brayton cylce with Regeneration Using Moist Air for Air Conditioning Cooled by Circulating Water By Hou Shaobo, Fan Shuanshi (International journal on Environmental sciences, 2011)

[5] Effect of Evaporator Temperature on Vapor Compression Refrigeration System by Abdullah, Al-Rashed (Alexandria Engineering Journal 2011)

[6] Influence of Outdoor Air Conditions on the Air Source Heat Pumps Performance by Pamela Vocalea, Gian Luca Morinib, Marco Spigaa (International journal on energy engineering, 2014)

[7] Experimental Study of a Liquid Dehumidification Unit Integrated in a CCHP System with Varying Operating Condition by Runhua Jiang, Frank G.F. Qin, Xiaoxi Yang, Simin Huang, Baiman Chen, Minlin Yang, Yongjun Xu,Youyuan Shao(International journal on energy engineering, 2015)

[8] An Experimental study on the Dehumidification Performance of a Low-Flow Falling-Film Liquid Desiccant Air-Conditioner by S. Bouzenadaa, C. McNevinb, S. Harrison c, A. N. Kaabid (International journal on energy engineering, 2015)

[9] Experimental Investigations on a Conventional Air Conditioner Working as Air-water Heat Pump by Yu Wanga, Yuwen Youa, Zhigang Zhang (International journal on energy engineering,2011)

[10] Heat Pump Unit Based on Principle of Stream Thermocompression Using Water-Ammonia Solution by Vyacheslav Arsenyeva, Sergej Vanyeyevb, Mykhail Protsenkoc, Alexander Gulyid,(International journal on energy engineering, 2012)

[11] Testing for Energy Recovery Ventilators and Energy Saving Analysis with Air-Conditioning Systems by Peng Yanga, Li Lia, Jianqin Wanga, Guilin Huanga and Jingli Penga,(International journal on energy engineering, 2015)

[12] The impact of split air condition supply temperature to indoor temperature field in winter by Wufeng Jina, Junwei Hea, Lin Lia (International journal on energy engineering, 2015)

[13] Experimental study of factors affecting the performance of a semi enclosed outdoor air-conditioning unit by Wufeng Jina , Yafei Zheng a, Yan Zhangb, Yuebo Jiangc (International journal on energy engineering, 2015)

[14] Performance Evaluations and Experimental Study of the Induction Radiant Air-conditioning System by Qiang Sia, Xiaosong Zhanga (International journal on energy engineering, 2015)

[15] An open Reversed Brayton cylce with Regeneration Using Moist Air for Air Conditioning Cooled by Circulating Water by Hou Shaobo1, Fan Shuanshi2 ((International journal on environmental sciences, 2015)