Flow and Thermal Analysis of Mobile Air Conditioning by using Roll Bond Evaporator

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Abstract— In all air conditioning and refrigeration equipment the equipment is either a plate and fin evaporator, tube and fin or a plate and tabular evaporator. For improving coefficient of performance and decreasing power consumption we use roll bond evaporator in air cooler model with static air conditioner and R134A (1,1,1,2-tetrafluoroethane) as refrigerant.

Key words: Air Conditioner, Air-Cooler Model, Roll Bond Evaporator, Static Air Conditioner Refrigerant R134A

I. INTRODUCTION

In modern world use of refrigeration and air conditioning systems is on rise. Room air conditioners are very common in comfort air conditioning system. Room air conditioners may be of window type or of split type. In India, it is estimated that approximately 70% of air conditioners are of window type. Window air conditioners of capacities 0.5 TR to 2 TR are very common in India. These contribute to steadily increasing energy consumption. There is need to develop higher efficiency products, which consume less energy while delivering the desired cooling effect. In this pursuit, it is found that the evaporator made from roll bond process gives more uniform distribution of cooling effect when compared to tube and fin evaporator. Roll bond evaporators can be easily manufactured and cost of manufacturing is also low.

Heat exchangers, including evaporators, are designed and employed according to two criteria: heat transfer and pressure drop.

II. LITERATURE REVIEW

A. *Working of Air Conditioner*

Before learning the operation of the air-conditioner system, we should know first about the significant components which they are applied in the refrigerant circulate system

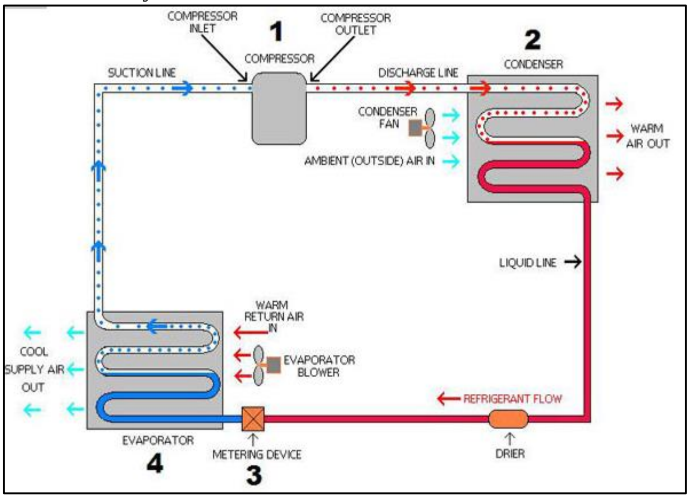


Fig. 1: Air conditioner working cycle.

1) Compressor: It drives the refrigerant flow into each part of the air-conditioner so these caused the temperature and the air pressure in the refrigerant being high.
2) Condenser: It drains heat from the refrigerant.
3) Evaporator: It can absorb and transfer the heat in the building to the refrigerant.
4) Throttling Device: It reduces the air pressure and the temperature in the refrigerant. Generally, it can be used as Capillary tube or Expansion Valve.

The cooling system as mentioned above is Vapour -Compression Circulate system which it has the simply working regulation via driving the refrigerant flow along the system and this also passed continually throughout 4 major components as Refrigerant Circulate system. Besides, the followings are its working process.

- Firstly, the compressor will absorb and charge the refrigerant for enhancing its pressure and temperature and also move it forward to the evaporator later.

- Then, the refrigerant will be flown throughout the evaporator by using the fan drain the heat out. So it caused the refrigerant's temperature in the evaporator which it is emanating being low. Next, this will be flushed to Throttling Device hereafter.
- Next, the pressure and temperature in the refrigerant that flown through Throttling Device will be quite low. After that, it will be flushed into the cooling coil (or it can be known mostly as "Refrigerant Injection").
- Later, the refrigerant will be circulated around the cooling coil which it used the fan to absorb heating in that room so it caused the room's temperature getting low and the refrigerant's temperature of emanating cooling coil getting high (stable pressure). Lastly, this refrigerant will be transferred back to the compressor for operating over circulated system continually.

After learning the refrigerant circulated system, it can be summarized as follows:

1) Refrigerant: It is functioned as a medium to absorb and drain heating from indoor out. Then, the refrigerant will be re-condensed once and transferred back into indoor for sucking the heat continually. Nevertheless, this process will be occurred progressively through the useful life of compressor.
2) Compressor: It's a single component in refrigerant circulated system which functioned in driving the refrigerant through the major component namely the evaporator, Throttling Device and the cooling coil. At all event, the compressor will start working when the temperature in indoor is getting higher than the temperature you have set. Therefore, the compressor will be started and also stopped working sporadically for maintaining the stable room's temperature as your requirement.

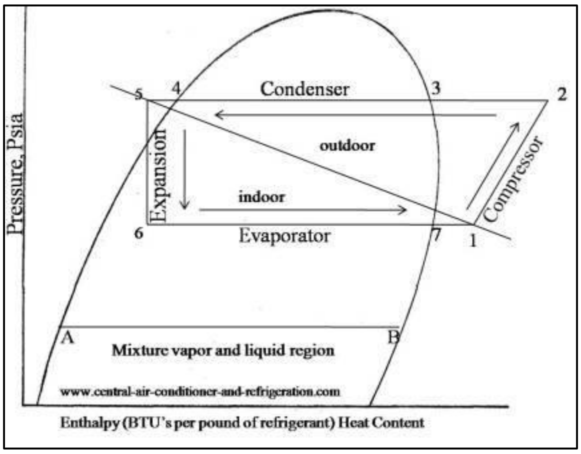


Fig. 2: Refrigeration cycle

III. REFRIGERANT

We use R134A or 1,1,1,2 Tetrafluoroethane as a refrigerant in our system, which is very safe to the environment i.e. ozone layer as it doesn't contain any chlorine atom in its structure and has a very low boiling and melting point i.e. -26deg Celsius and -110 deg Celsius.

IV. DESIGN OF MOBILE AIR CONDITIONER

Design of a mobile air conditioner is done using AutoCAD 3D. The parts of air conditioner are compressor, condenser, evaporator, capillary tube and cooler fan.

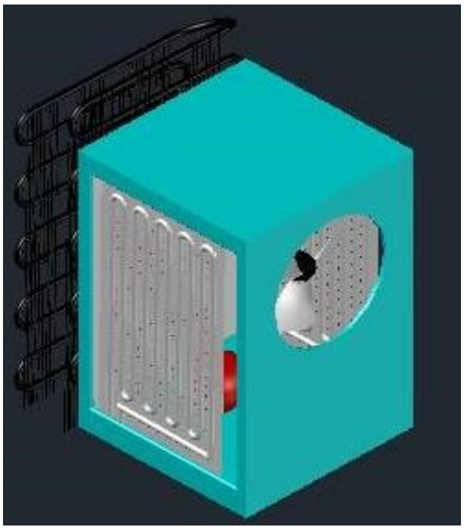


Fig. 3: Design of Mobile Air Conditioner

V. RESULTS AND CONCLUSIONS

In the present work we have identified there are 12 critical areas where all these conditions place a vital role in the present specified application, from the cooling effect of modified air cooler. The table 2 shows the thermocouples results the thermocouple are placed the 12 critical areas are identified as shown in the table.2.

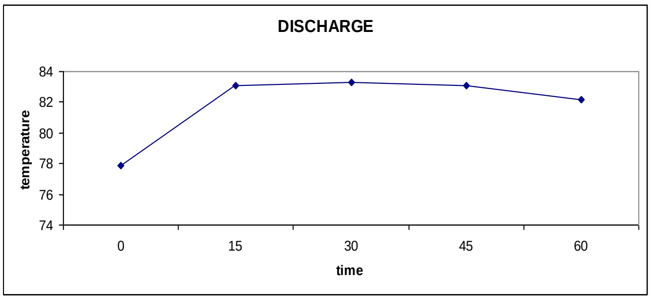
The following results are explained in detail with the results obtained by the thermo couples as follows below

Component	Material	Specifications	Quantity
Compressor		Type:-reciprocating hermetic compressor	1
		Power-193watts	
		Capacity- 1700btu/hr	
Condensor		Static air condensor	1
		capacity-1ton	
Evaporator	Aluminium plates	Plate type evaporator i.e, roll bond evaporator	4
Expansion Devices	Copper tube	capillary tube	4
		length-5mts	
		diameter-.4mm	
Fan	Thermo set plastic	three blade tarbo fan	1
Screws	Mild steel	M12 TYPE	20
Global Valve	Bronze brass	FH type	2
Ball Valve	Brass	s1 type	4
Motor		Electric motor	1
		power-120 watts	
		RPM-1400	
Refrigerant	R134A		

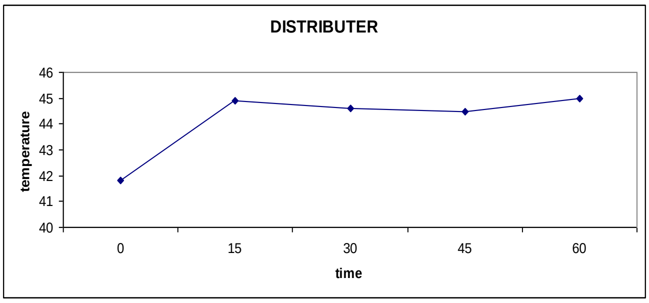
Table 1: Bill of Materials

TEMP/TIME	0	15	30	45	60
Suction	30	29.2	29.5	29.2	29.4
Discharge	77.9	83.1	83.3	83.1	82.2
Distributer	41.8	44.9	44.6	44.5	45
Top of Compressor	52.7	61.1	61.4	62.2	62.7
Bottom of Compressor	42.2	64.1	64.4	65.1	65.8
Condenser Input	64.8	60.5	62.5	61.9	61.8
Condenser Middle	45.4	48.9	48.3	48.2	48.6
Evaporator Input	7.1	10.1	8	8.2	8.4
Evaporator Output	23.5	27.4	26.3	24.9	25.9
Evaporator Input	8.2	10.5	8		8.2
Evaporator Output	20.4	25.6	23.9	23.7	23.7
Ambient Temperature	30	28.3	27	26.8	26.5

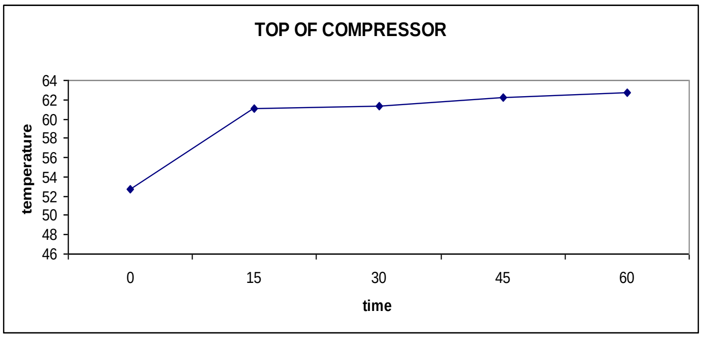
Table 2: Thermocouple Readings



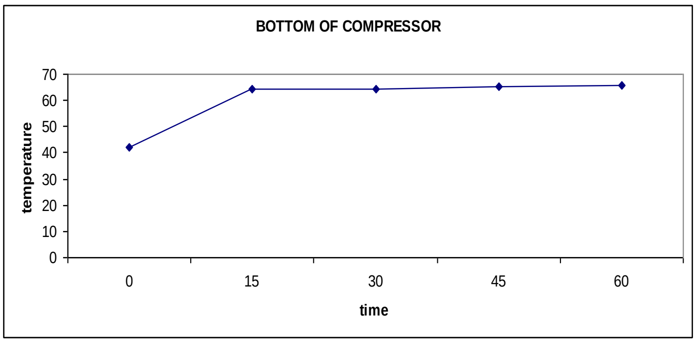
Graph1: Temperature at Suction



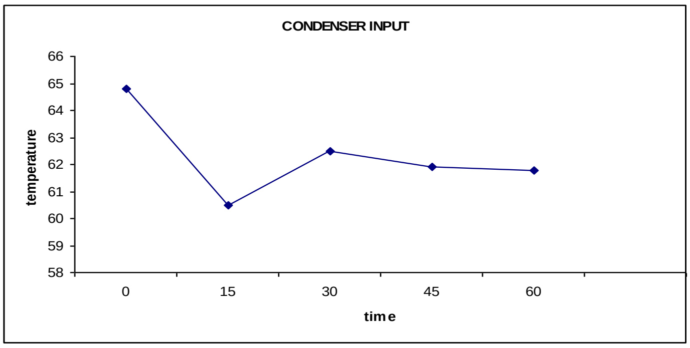
Graph 2: Temperature at Discharge



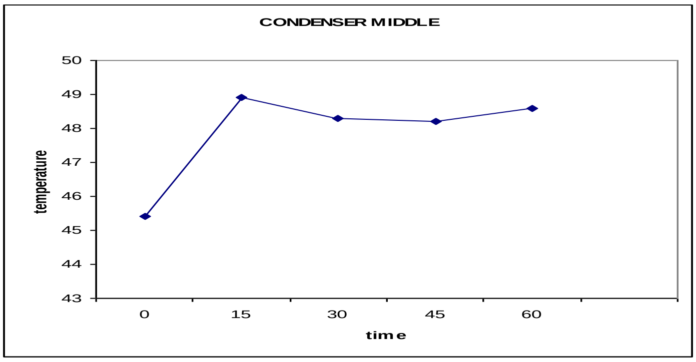
Graph 3: Temperature at Discharge



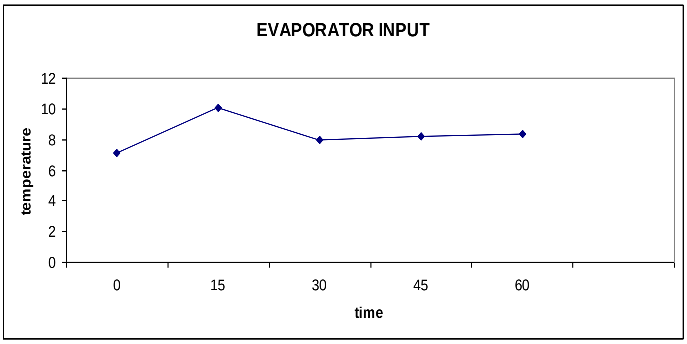
Graph 4: Temperature at Discharge Input



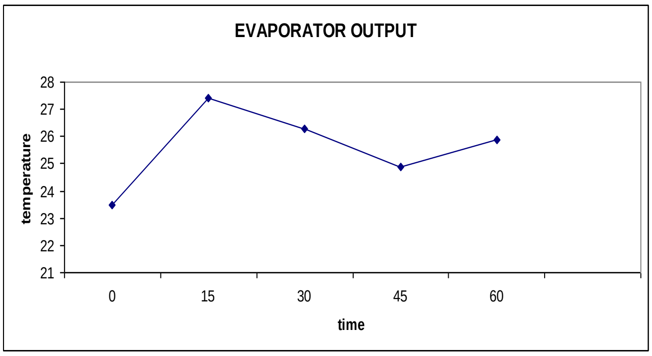
Graph 5: Temperature at Distributor



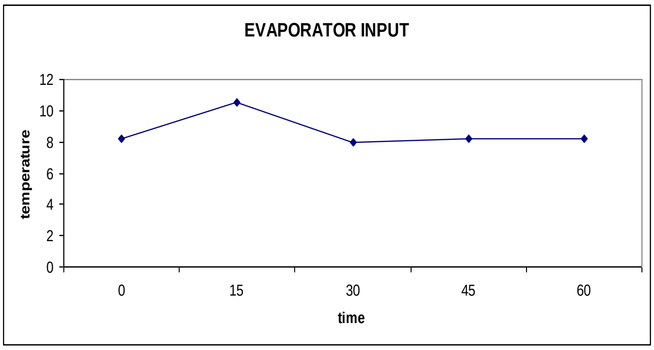
Graph 6: Temperature at top of compressor



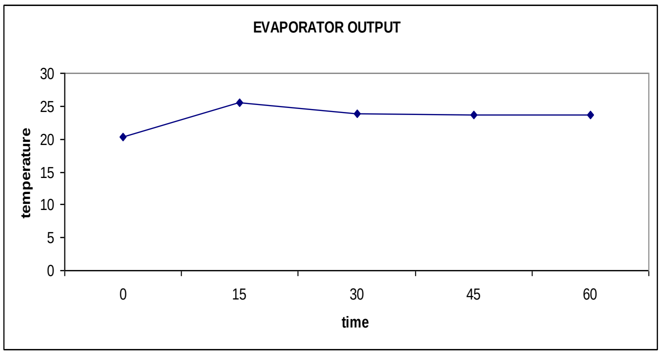
Graph 7: Temperature at Condenser Middle



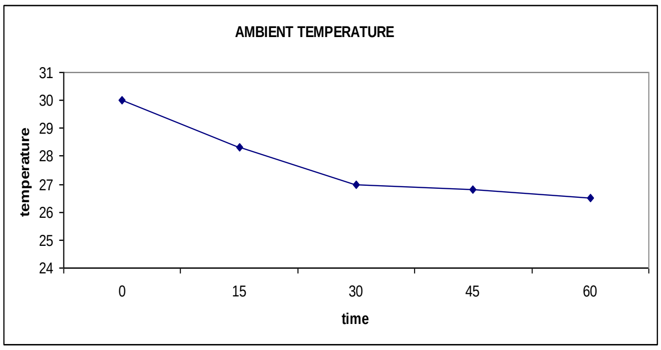
Graph 8: Temperature at Evaporator Input



Graph 9: Temperature at Evaporator Output



Graph 10: Temperature at Evaporator Input



Graph 11: Ambient Temperature

VI. CONCLUSION

The experimentation and testing of a mobile air conditioner carried out using the air conditioner cycles and obeying all the laws of human comforts, the conclusions are drawn from results and discussions. After conducting the experimentation and testing, we understood the future scope of our work. We can improve the human comfort as per the standard air conditioner test room.

Hence, we can say that this mobile air conditioner is portable and very economical as well as eco-friendly when compared to traditional air conditioner

REFERENCES

[1] Refrigeration and air conditioning by R S Khurmi
[2] http: / /www.airconditioning-systems.com
[3] http: / /www.samsung.com/
[4] http: / /www.air-conditioning-and-refrigeration-guide.com/
[5] http: / / www.air-conditioning-and-refrigeration-guide.com/
[6] P.S.Ravi, Dr Arkanti Krishnaiah , Dr Suresh Akella , Dr Md. Azizuddin, "Evaluation Of Inside Heat Transfer Coefficient of Roll Bond Evaporator for Room Air Conditioner," International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4,Issue 5, May 2015, pp. 3378-3384.
[7] Fieramonte, Luigi, "An improved refrigerating container and a process for manufacturing the same," European Patent Specification :EP No 1016838A1, 1998
[8] Christian J.L Hermes, Claudio Melo, Cezar O.R. Negrao , "Anumerical simulation model for plate-type, roll-bond evaporators", Science Direct, Elsevier, International Journal of Refrigeration Vol 31,pp 335-347, 2008.
[9] Bio Pierre, "Flow Resistance with Boiling Refrigerants," ASHRAE J, Vol 6, Nos 9 and 10, 1964.