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# Evaluating geometry of evaporator for refrigerator enhancing efficiency of heat transfer

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**ABSTRACT**

**An evaporator is the main component of refrigeration system mainly used in different refrigeration and air-conditioning applications in food and cold storage, in the mechanical industry etc. Evaporator in air conditioning system is used to evaporate liquid and convert in to vapor and absorbing heat in the processes for the refrigeration cycle to be efficient and design parameters for it's key components play a vital role. This research work, effort is to identify the effect of geometry for the evaporator coil over the performance of the refrigerator. The present work is to analyze performance of refrigeration system on two evaporator microchannel and fin tube using R134a refrigerant. These two evaporator are kept in one unit with other components of same parameter for both evaporatorinrefrigerating unit while construction. Performance of refrigeration system is checked for each evaporator at various load.The performance of the evaporator is measured for whole refrigeration unit in terms of coefficient of performance, heat transfer, coefficient efficiency of the system and cooling capacity. The experimental data of heat transfer coefficient is validated with existing correlation and coefficient of performance of the system with the microchannel evaporator is found higher than that with the fin tube evaporator.**

**Keywords**— **Microchannel evaporator, Fin tube evaporator,Geometry, C.O.P, Performance curve.**

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## I. INTRODUCTION

Refrigeration is technology in a wide range of applications from air conditioning for occupant comfort to freezing gas required in food preservation. In cooling system evaporators are the main component responsible for extracting heat from conditioned spaces.The focus of this paper is on evaporators that cool air to temperatures below the freezing point of water, air-cooling evaporator operates at a temperature below the freezing point with entering air dew point temperature that is above the evaporator coil surface temperature and frost will form on the evaporator. Within the evaporator refrigerant is evaporated by the heat transferred from the heat source. Source of heat may be a gas and liquid. At the time of evaporation, the temperature of a pure refrigerant is constant, as long as the pressure does not change. If low refrigerant temperature is obtain as a result of the loss in pressure caused by the compressor. At the starting of compressor the pressure reduced, that time equilibrium between liquid, vapour in the evaporator is disturbed. To obtain equilibrium position, more vapour is formed through evaporation of liquid. Evaporator is one of our basic and necessary hard-ware components of the refrigeration system. Pressure drop, heat transfer rate, evaporation rate and most important thing is efficiency of evaporator, to increase all four things and improve by getting optimum parameter of evaporator, required optimum parameter of evaporator are generated with the help of experimental data. The equations of fluid mechanics which have been known or over a century are solvable only or a limited number of flows. Public awareness of environmental issues for an growth of energy efficiency and a reduction in the usage of refrigerants. In the refrigeration industry these demands are consider into account by enhancing the thermal performance while minimizing the charge of refrigerant. Another way to accomplish that goal is to usemicrochannel heat exchangers which give low internal volume lead to a significant reduction of the refrigerant charge. Minimum energy consumption, refrigerant charge in refrigeration systems is increasingly important for environmental, legislative and economicalreasons.

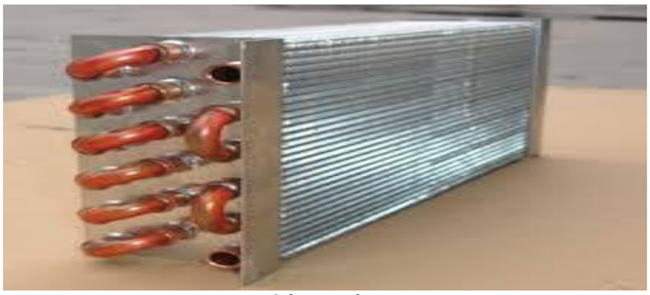

Fig.1Typical figure of evaporator

Increasing concerns about climate change provide a new design factor for conventional systems striving for high Efficiency and energy conservation at a given production cost. This entire factor is the preference to use refrigerantswhich gives a low global warming potential, with other things being equal. Considering that the system's indirect contribution to climate change (CO2 emissions from fossil fuel power plants generating electricity to drive the system) is dominant for most applications, this is important to obtain accurately determine performance merits of different fluids.[6] In refrigeration evaporators and condensers used are typically of the round tube and fin type. Aluminiummicrochannel heat exchangers with flat tubes are used in automobile applications. Which are used in, condenser and evaporator. All designs use high performance louvered fins. Condensers use a small hydraulic diameter extruded aluminium tube having internal membranes gives high strength to support the internal pressure of refrigerant.[7] Fin tube heat exchangers are widely used as condensers and evaporators in a domestic air-conditioning. Within the forced convective heat transfer between air and refrigerant, the controlling thermal resistance is on the air-side. For improve the air side performance, large efforts has taken, include a usage of high performance fins, usage of small diameter tubes. However, fin tube heat exchangers have more problems such as the contact resistance between fins and tubes, in existence of a low performance region behind tubes, etc. This entire problem may be overcome if fins and tubes are soldered,low profile flat tubes with high performance fins are used. Brazed aluminium flat-tube heat exchangers with louver fins could be the choice. Flat tube heat exchangers have been used as condensers of automotive air conditioning units for more than ten years, and they are replacing fin tube condensers of residential air-conditioning units. Condition of replacing the residential fin tube heat exchangers by flat tube heat exchangers has been studied by Webb and Jung (1992). It gives, for the same air-side thermal capacity less than half the heat exchanger volume compared with the fin and tube counterpart.[11]For the climate change provide a new design factor for conventional systems for high efficiency and energy conservation at a given production cost. Above new factor is the preference to use refrigerants that will low global warming potential, with other things being same. Including that the system's indirect contribution to climate change (CO2 emissions from fossil fuel power plants generating electricity to drive the system) is dominant for most uses, it is important to give accurately determine performance merits of different fluids, and in particular their performance potential in optimized equipment.[12]

## II. CLASSIFICATION OF EVAPORATOR

There are several ways of classifying the evaporators depending upon the heat transfer process or refrigerant flow or condition of heat transfer surface.

### *A. Natural and Forced Convection Type*

The evaporator may be classified as natural convection type or forced convection type. In forced convection type, a fan or a pump is used to circulate the fluid being refrigerated and make it flow over the heat transfer surface, which is cooled by evaporation of refrigerant. In natural convection type, the fluid being cooled flows due to natural convection currents arising out of density difference caused by temperature difference. The refrigerant boils inside tubes and evaporator is located at the top. The temperature of fluid, which is cooled by it, decreases and its density increases. It moves downwards due to its higher density and the warm fluid rises up to replace it.

### *B. Refrigerant Flow Inside or Outside Tubes*

The heat transfer phenomenon during boiling inside and outside tubes is very different due to this evaporators are classified as those with flow inside and outside tubes. In natural convection type evaporators and some other evaporators, the refrigerant is confined which boils inside the tubes while the fluid being refrigerated flows over the tubes. The direct expansion coil where the air is directly cooled in contact with the tubes cooled by refrigerant boiling inside is an example of forced convection type of evaporator where refrigerant is confined inside the evaporator. In many forced convection type evaporators, the refrigerant is kept in a shell and the fluid being chilled is carried in tubes, which are immersed in refrigerant. Shell tube type brine and water chillers are mainly of this kind.

### *C. Flooded and Dry Type*

The third classification is flooded type and dry type. Evaporator is said to be flooded type if liquid refrigerant covers the entire heat transfer surface. This type of evaporator uses a float type of expansion valve. An evaporator is called dry type when a portion of the evaporator is used for superheating the refrigerant vapour after its evaporation.

## III. LITERATURE REVIEW

Cesare Maria JoppoloandLucaMolinaroli(2011)[1], Experimental analysis of frost formation with the presence of an electric field on fin and tube evaporator. This work content with an experimental study to find the influence of DC electric fields on the performance of a fin and tube evaporator under frosting position. Number of experiments is carried out measuring frost mass, pressure drop, cooling capacity for different applied voltage, velocity of air and temperature of evaporation. Experimental result gives the electric field reduces the frost condition and pressure drop whereas it increases the cooling capacity. With provided electric field, the whole energy consumption of the refrigerating system reduces when referred to the same refrigerating effect.

Martin RyhlKaernandBrianElmegaard(2012)[2], Presented paper on comparison of fin tube interlaced and face split evaporators with flow maldistribution and compensation.Maldistribution in fin tube evaporators for residential air-conditioning is investigated by numerical simulation. Within particular, the interlaced and the face split evaporator are compared in flowmaldistribution conditions. Consider sources ofmaldistribution are the liquid and vapor distribution and the airflow distribution. Requirement of flow maldistribution by control of each channel superheat is studied for each evaporator. For Interlaced evaporator flow is bettermaldistribution than the face split evaporator. Each channel superheats are controlled, all face split evaporator achieves the best performance, i.e. an increase of 7% in overall Heat transfer value and 2.4% in COP compared to the interlaced evaporator without any problem.

Silvia MinettoaandRicardoBrignoli(2013)[3], Presented paper on experimental analysis of a new method for overfeeding multiple evaporators in refrigeration systems An innovative method for feeding flooded evaporators, keep in parallel in plants, is presented. To improve evaporators overfeeding ejector circulates liquid from the low pressure receiver back to the intermediate pressure receiver. Therefore there is not a need for superheat at the evaporator exit, evaporator expansion valve can be controlled by a signal representative, the evaporator load, or evaporator performance, for air temperature at its inlet or outlet. If compared to dry expansion evaporator systems, proposed solution offers energy saving and smooth operating positions, typical of flooded evaporators, while still maintaining a simple plant lay-out. Given concept is experimentally validated. All Evaporators are maintained in flooded conditions, and ejector is able to promote liquid recirculation. Direct comparison with dryexpansion operations was performed. Suggested method is mainly gives for commercial refrigeration system, where many evaporators are arranged in parallel.

J.M.MendozaMiranda and J.J. Ramrez-Minguela(2014)[4], Present paper on development and validation of a micro-fin tubes evaporator model using R134a and R1234yf as working fluids. Paper presents a model of shell tube evaporator with micro fin tubes using R1234yf and R134a. Developed Model for this evaporator uses the ε-NTU method to determine the evaporating pressure, refrigerant outlet enthalpy and the outlet temperature of the secondary fluid. Model accuracy is evaluated using different two phase correlations of flow boiling for micro fin tubes and comparing predicted and experimental data. In experimental tests were carried out for a wide range of operating conditions using R134a and R1234yf as working fluids. Predicted parameter with maximum deviations, within the numerical and experimental data is the evaporating pressure. The correlation of AkhavaneBehabadi et al. is use to predict flow boiling heat transfer, consist an error on cooling capacity prediction below 5%. Simulations, carried out with this validated model, gives that the overall heat transfer coefficient of R1234yf has a maximum decrease of 10% compared with R134a.

Jieun Hwang and KeumnamCho(2014)[5], Presented paper on numerical prediction of frost properties and performance of fin tube heat exchanger with plain fin under frosting. The present study predicted and verified the local frost thicknesses, ,and localblockage ratio and total heat transfer rates of a finetube heat exchanger under standard and high frosting conditions. Local frostproperties are predicted for eachsegment. Reductionof air volume flow rate and local different air velocities. Higher frost thicknesses showed a deviation of 5.5% from the measured values. Maximum frost thicknesses after each U-bend were thicker than those immediately before each U-bend. Determine blockage ratios agreed with themeasureddatawithin 10%. Non-uniform profiles of the local heat transfer rates of heat exchanger under frosting condition are property predict. Obtain total heat transfer rate agreed with the measured data within 6%.

Kiran.B.Parikh and Tushar.M.Patel(2014)[6], Presented paper on analysis and validation of fin tube Evaporator. An Evaporator is the Main component of Air-conditioning system. Evaporator is mainly used in different refrigeration and air conditioning applications in food and beverage industry in the pharmaceutical industry. The evaporator in air conditioning system is used to evaporate liquid and convert in to vapour while absorbing heat in the processes, Itpresents the study of the fin tube type Evaporator and experimental data are collected from the Company. while collecting data of fin tube evaporator model is prepared using solid works. FEA analysis is carried out on it using ANSYS CFX, The result of analysis is compared with Experimental result. 3.7% variation found in both results.

SerdarCeli, Emmanuel C. (2014)[7], Performance analysis of a refrigerating system with a grooved-tube Evaporator. Tube with groove heat exchanger was developed and applied as an evaporator of a refrigerating system. Analysis carried out to evaluate the performance of the refrigerator. Isobutane (R-600a) is employ as the working fluid. The Study areperformed on the system but with the same size of a regular tube evaporator. various refrigerating systems had compared in terms of heat exchanger , coefficient of performance, two phase pressure drop. Performance of heat exchanger effectiveness of the groovedtube evaporator had found to be higher compared to the regular-tube evaporator. Coefficient of performance of the system with the grooved tube evaporator was also observed to be high. If the pressure drop for the grooved tube evaporator was slightly higher than that for the regular tube evaporator, compressor demand for this increase was not very significant.

Bruno N. Borges and CláudioMelo(2014)[8],Transient simulation of a two-door frost free refrigerator subjected to periodic door opening and evaporator frosting.This paper describes a quasi steady state simulation model for predicting the transient behavior of two door household refrigerator subjected to periodic door opening and evaporator frosting. Semi empirical steady state model was developed for the refrigeration loop; model of transient condition is devised to find the energy and mass transfer into and within the refrigerated compartments, also the frost designup on the evaporator. Important key empirical heat and mass transfer parameters required by the model were derived from a set of experiments performed in house in a climate controlled chamber. It was found that the model predictions followed closely the experimental trends for the power use and for the compartment temperatures when the doors are opened periodically and frost is allowed to accumulate over the evaporator

### *A. Concluding Remark from Literature Review*

Many researchers used microchannel evaporator having classification horizontal, single port, multiport, rectangular and cylindrical. From review it can be seen that there is scope to find heat transfer coefficient for horizontal, multiport and square type microchannel evaporator to find heat transfer coefficient. From study of above research paper following concluding remark is drawn that Thermal performance of evaporator depend upon

- Flow rate of air through the evaporator coil.
- Refrigerant circuitry of the evaporator coil.
- Direction of air flow with respect to evaporative coil
- Misdistribution, Non uniform air flow reduces the C.O.P.
- Microchannel evaporator moretransient behavior than the fin and tube evaporator.
- Heat transfer rates in refrigeration system can be improved by different techniques like internal microfins, wire insert and microchannel evaporators etc.

### B. *Objective*

1) To develop experimental setup of refrigeration system with suitable microchannelevaporator.
2) To predict the coefficient of performance of microchannelevaporator on the refrigeration system.
3) To reduce the system refrigerant charge.
4) To develop more compact system.
5) To find the coefficient of performance of microchannel evaporator and comparing with finned tube evaporator.
6) To find separate parameter of evaporators like cooling rate, heat absorb by evaporator using R134a (Tetrafluroethane) to study the heat absorb in microchannel evaporator.

## IV. EXPERIMENTAL SETUP

### A. *Basic vapour compression cycle*

Phase change between the liquid and gaseous states for a temperature which depends on its pressure of given limit to its freezing point and critical temperature. During boiling fluidmust obtain the latent heat of evaporation and during condensing the latent heat must be given up again. Basic refrigeration cycle makes use of the boiling as well as condensing of a working fluid at verious temperatures, therefore, at different pressures. Heat is put into the fluid at the lower temperature and pressure and provides the latent heat to make it boil and change to a vapour. This vapour is then mechanically compressed to a higher pressure and a corresponding saturation temperature in which its latent heat be rejected so that it changes back to a liquid. Fig. 2 shows experimental set up for analysis work it is vapour compression system in which fin tube evaporator and microchannel evaporator are connected parallel to each other and flow of refrigerant control by valve. By using valve we provide the refrigerant supply at a time only one evaporator either fin tube evaporator or Microchannel evaporator.

Fig.2Experimental setup

*1)Thermocouples:*It is use to measure the temperature of refrigerant at inlet and outlet from condenser, compressor and evaporator. It is also used to measure ambient temperature and exit air temperature from condenser. There are twelve numbers of thermocouples are as follows:
Refrigerant temperature: $T_1$, $T_2$, $T_3$, $T_4$, $T_5$, $T_6$, $T_7$, $T_8$
Ambient temperature : $T_9$
These nine thermocouples are connected to multi point temperature indicator to measure the fin temperature at different locations.


Fig.3 Multi point temperature indicator

The specification of each thermocouple:
T1: Refrigerant inlet temperature to Compressor in $^0$C
T2: Refrigerant Outlet temperature from compressor in $^0$C
T3: Refrigerant outlet from condenser
T4: Refrigerant inlet to fin tube evaporator.
T5: Refrigerant outlet from fin tube evaporator
T6: Temperature inside the close box
T7: Refrigerant inlet to microchannel evaporator
T8:Refrigerant outlet temperature from microchannel evaporator
T9: Ambient air temperature

*2) Hermetically sealed Compressor:*In hermetic compressors, motor and the compressor have enclosed in the same housing to prevent leakage of refrigerant. Housing is welded connections for refrigerant inlet as well as outlet and for power input socket;there is virtually no possibility of refrigerant leakage from the compressor. Same way the compressor also gets heated-up due to friction and also due to temperature rise of the vapor at the time of compression. For open type, compressor and the motor normally reject heat to the surrounding air for normal operation. But in hermetic compressors heat cannot be rejected to the surrounding air because both are enclosed in a shell.

Fig.4Compressor

Hence, the cold suction gas is made to flow over the motor and the compressor before entering the compressor. Due to this keeps the motor cool. Cooling rate depends upon the flow rate of the refrigerant and its temperature, the thermal properties of the refrigerant. However flow rate is not sufficient and if the temperature is not low enough the insulation on the winding of the motor can burn out and short-circuiting may occur. Due to this reason hermetically sealed compressors give satisfactory and safe performance over a very narrow range of design temperature and it should not be used for off-design conditions.

*3) Fin Tube Evaporator:*In fin tube type evaporator, the circulation of air over the evaporator surface is maintained by using a fan or a blower. These evaporators normally use fins on air-side for good heat transfer. The fins may be plate type and annular type. Actual view of fin tube evaporator shown in fig.5

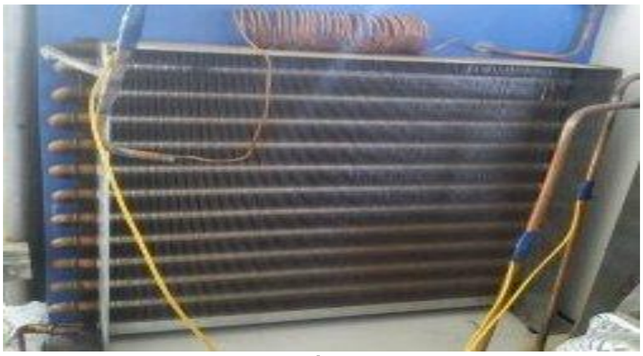

Fig.5 Fin Tube evaporator

*4) Micro-channel evaporator:*

Microchannel heat exchangers have started to be used in refrigeration and air conditioning systems mainly consists of microchannel tubes with louvered fins. This type of evaporator consist of header tubes on both sides. For the header inlet and outlet for the refrigerant are provided. Parallel flow parallel flow evaporator, widely used in automotive A/C system consists of a typical microchannel heat exchanger.

Fig.6Microchannel evaporator

TABLE I

| Dimension | Micro-channel | Fin Tube evaporator |
|---|---|---|
| Face area (m2) | 1.28 | 1.36 |
| Depth (m) | 0.021 | 0.0191 |
| Volume (m3) | 0.0262 | 0.0270 |
| Are side area | 45.02 | 46.01 |
| Tube O.D (mm) | 13 | 10.25 |

In a Parallel flow evaporator evaporator, refrigerant flows through microchannel tubes in parallel within the same pass while in series from pass to pass. The mass flow of refrigerant in any pass is a constant at a stable position. The dimension and specification of microchannel evaporator used in set up as given in table I.

*5) Pressure gauges:*Direct indication of the operating conditions of a compressor is by pressure gauges at suction, discharge and oil delivery.


Fig.7 HP & LP Gauges

Such gauges are mounted on or near the compressor. Therefore the pressure losses along the discharge and suction of thesystem are comparatively small on most systems, pressures will also approximate to the conditions in the evaporator and condenser, the equivalent saturation temperatures will be the condensing and evaporating temperatures.

## V. EXPERIMENTATION

For the analysis of refrigeration system using microchannel evaporator set up is built to find various parameters. Measurement parameters are actual coefficient of performance, cooling capacity,theoretical coefficient of performance, mass flow rate of refrigerant, cooling capacity. From various operating conditions the data obtained from refrigeration system using microchannel evaporator is compare with round tube and fin tube evaporator. In experimental procedure, performance of microchannel evaporator and fin tube evaporatorusing refrigerant R134a. At different load various range of pressure and temperatures obtained which are shown in tabulate form in table II,Observation table readings of refrigeration system using R134a refrigerant.Readings at control panel for cooling load (R134a)

### *A. Observation Table*

TABLE III

Readings at load Q=50Watt, Fin Tube evaporator

| T1 | T2 | T3 | T4 | T5 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 30 | 46 | 33 | 12 | 29 | 18 | 10 | 140 | 30 |

 

Microchannel evaporator

| T1 | T2 | T3 | T7 | T8 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 24 | 50 | 36 | 13 | 27 | 13 | 10 | 140 | 30 |

Readings at load Q=120Watt, Fin Tube evaporator

| T1 | T2 | T3 | T4 | T5 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 30 | 44 | 32 | 15 | 27 | 18 | 10 | 140 | 30 |

Microchannel evaporator

| T1 | T2 | T3 | T7 | T8 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 28 | 48 | 33 | 08 | 27 | 13 | 10 | 140 | 30 |

Readings at load Q=150 Watt, Fin Tube evaporator

| T1 | T2 | T3 | T4 | T5 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 30 | 49 | 37 | 14 | 28 | 19 | 10 | 140 | 30 |

Microchannel evaporator

| T1 | T2 | T3 | T7 | T8 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 27 | 51 | 34 | 10 | 27 | 14 | 10 | 140 | 30 |

Readings at load Q=180Watt,Fin Tube evaporator

| T1 | T2 | T3 | T4 | T5 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 30 | 57 | 35 | 12 | 27 | 19 | 10 | 140 | 30 |

Microchannel evaporator

| T1 | T2 | T3 | T7 | T8 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 27 | 54 | 35 | 11 | 26 | 14 | 10 | 140 | 30 |

Readings at load Q=200Watt, Fin Tube evaporator

| T1 | T2 | T3 | T4 | T5 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 30 | 54 | 35 | 08 | 26 | 20 | 10 | 140 | 30 |

Microchannel evaporator

| T1 | T2 | T3 | T7 | T8 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 28 | 52 | 36 | 10 | 26 | 15 | 10 | 140 | 30 |

### *B. Mathematical Procedure*

Sample calculation gives procedure to calculate refrigeration parameters like coefficient of performance actual, coefficient of performance theoretical, Heat Rejection Ratio, and Heat rejected from condenser, efficiency of refrigeration system for heat input at 50 KW is given below.

Reading on refrigeration system using R134a refrigerant

Readings at load Q 50Watt

Ambient temperature= 320C

TABLE IIII

Fin Tube evaporator

| T1 | T2 | T3 | T4 | T5 | T6 | V(LPH) | H.P(PSI) | L.P.(PSI) |
|---|---|---|---|---|---|---|---|---|
| 30 | 46 | 33 | 12 | 29 | 18 | 10 | 140 | 30 |

Procedure to find actual coefficient of performance, theoretical coefficient of performance, cooling capacity.

CompressorPower (Wactual) = (Nc*3600)/(emc*tc)

= (10*3600)/(3200*62)

= 0.181Kwatt

LowPressure

= 30 PSI

= ( 30)/14.5 + 1.0133

= 3.0821 bar

High Pressure = 140 PSI

= 140/14.5 + 1.0133

= 10.668 bar

Theoretical C.O.P.

= (h1-h4)/(h2-h1)

(h1=Entalpy of refrigerant at compressor inlet, h4=Entalpy at evaporator inlet, h2=Enthalpy at compressor outlet)

= (605-477)/(638-605)

(From p-h chart R134a)

= 3.87

Actual C.O.P.

= Refrigeratingeffect/CompressorPowerinput

= (maCpa(Ta-T6))/181

Mass flow rate of air = = 1.5 m3/min

0.03063 Kg/sec

Actual C.O.P.

= (0.03063*1.005*(32-20))/(0.181 KJ/sec)

= 2.0408

Cooling Capacity

= mrefCpg (T5– T4)

(mref=mass flow rate of air,

Cpg=Specific heat of refrigerant KJ/Kg 0C)

= 0.0028*965*(29-12)

= 45.93 Watt

## VI. RESULT AND DISCUSSION

The experimental data obtained from two evaporators are presented in this chapter. To compare performance analysis of refrigeration system usingmicrochannel evaporator and fin tube evaporator with refrigerant R134a various graphs are plotted. Effect of heating load on actual coefficient of performance of system using R134a

The coefficient of performance givesthe performance of a thermodynamic cycle or a thermal system. Because the C.O.P Can be greater than 1, It is used instead of thermal efficiency.

### *A. Effect of cooling load on efficiency of evaporator using R134a*

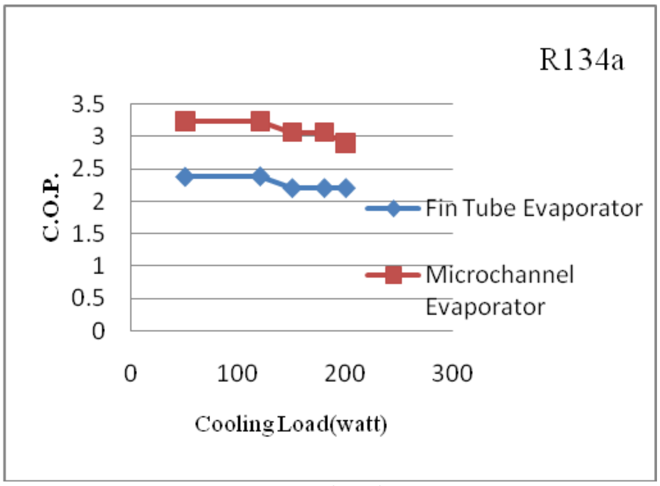


Fig.8C.O.PVs Heating load for refrigerant R134a

The coefficient of performance can be used for the analysis of the following:

- Coefficient of performance of the system remains same for various heating load.
- We can see that the coefficient of performance of Microchannel evaporator is greater than fin tube evaporator.

*B. Effect of heating load on efficiency of evaporator using R134a*

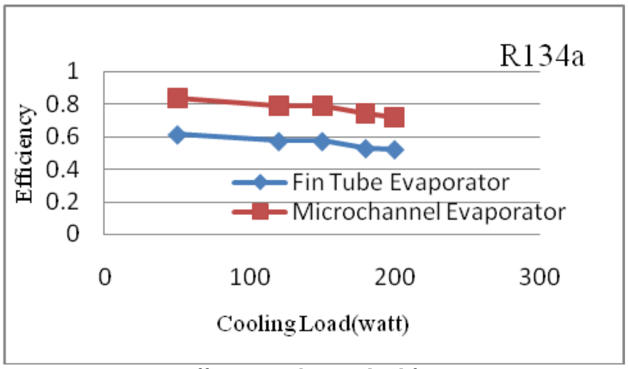


Fig.9 EfficiencyVs heating load for R134a

From fig.9 effect of cooling load on efficiency using R134a can be seen that the efficiency of evaporator for various load remain sameand efficiency of microchannel evaporator is more than fin tube evaporator.

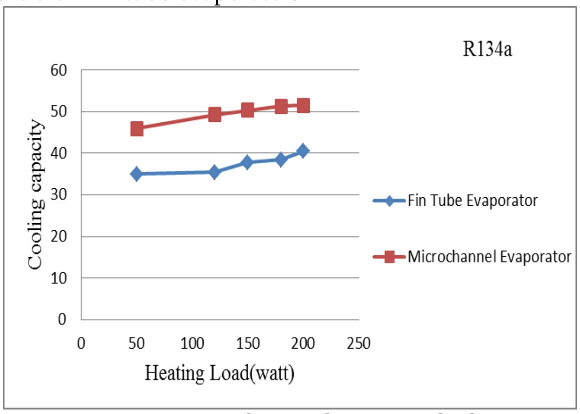


Fig.10 C.O.P theoretical Vs Heating load

*C. Effect of cooling capacity on heating load using R134a*

From fig.10 we can see forabove designed system as the cooling load increase then cooling capacity also increases up to certain level for both evaporator and cooling capacity for microchannel evaporator more than the fin tube evaporator.

*D. Effect of temperature on energy consumed*

Fig.11 shows effect temperature on total energy consumed to obtain cooling effect for the system. For fin tube evaporator temperature decreases from 32 $^{O}$C to 18$^{O}$C and for micrichannel evaporator temperature decreases from 32$^{O}$C to 13$^{O}$C. Total energy consumed by the fin tube evaporator is more as compared to the microchannel evaporator for obtain cooling effect.

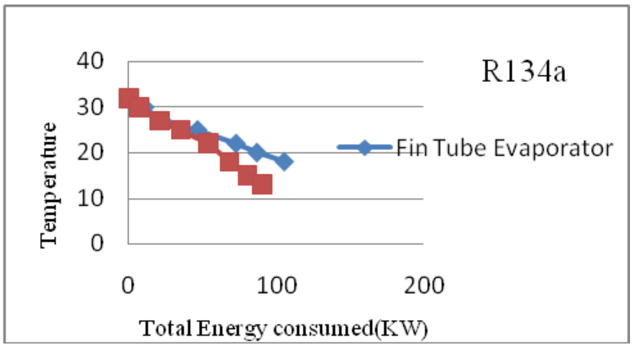


Fig.11 TemperatureVs Energy consumed

*E. Effect of Temperature onTime*

When the initially system is started that time as the time increases temperature is continuously decreases up to certain level and maintain constant, For microchannel evaporator rate of decrease in temperature is more as compare to fin tube evaporator.

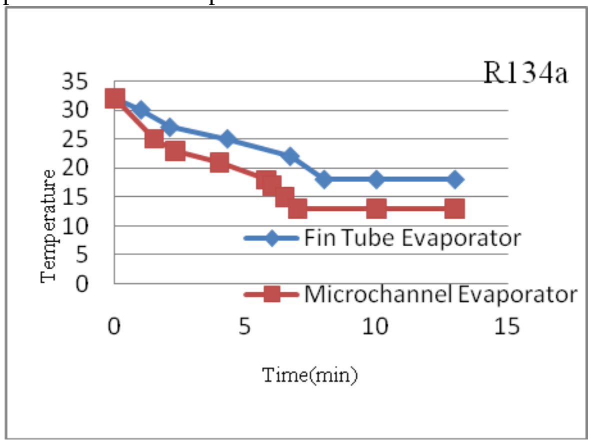


Fig.12 TemperatureVs Time

## VII. CONCLUSION

The present work is to find performance analysis of refrigeration system using microchannel evaporator and fin tube evaporator with refrigerant R134a. Experiments are performed to find the effects of cooling load, coefficient of performance, cooling capacity, and Total energy consumed.

For refrigerants R134a coefficient of performance remain same with increase in cooling load.C.O.P of refrigeration system using microchannel evaporator is more compared to fin tube evaporator. The C.O.P of the system with the microchannel evaporator is found 26.31 % higher than that with the fin tube evaporator using R134a.

For evaporator parameters, compressor, condenser and refrigerant flow rate kept constant throughout the analysis. Cooling capacity of microchannel evaporator is 23.8% higher compared to fin tube evaporator.

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