Optimization of Air Conditioner Condenser Using R404 to Improve Heat Transfer Rate

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Abstract:
Air conditioning systems have condenser that expels undesirable heat from the refrigerant and exchanges that heat outside. The essential part of a condenser is regularly the condenser coil, through which the refrigerant flows. Since, the AC condenser coil contains refrigerant that retains heat from the encompassing air, the refrigerant temperature must be higher than the air. In this paper, an air cooled condenser is designed and modeled in 3D modeling software Pro/Engineer. Present utilized material for tube is copper and for fins is Aluminum Alloy 204. In this paper, the tube material is copper, but the fins materials taken are Aluminum alloys 1100, 6063 whose thermal conductivities are more than that of Aluminum alloy 204.Thermal analysis is done to determine the heat transfer rate by changing the fin material. The refrigerant considered is R404 . Thermal analysis is done in simulation module of Solid works, Cosmosworks.The best material and best fluid for the condenser can be checked by comparing the results. Pro/Engineer is a parametric 3D modeling software and Cosmos works is analysis software.

Keywords: Aluminum alloys 1100, 6063.Refrigerant R404

I.INTRODUCTION

1.1 Air Conditioning

The purpose of air conditioning[14] is to supply adequate volume of clean air containing a particular measure of water vapor and at a temperature fit for keeping up foreordained air conditions within a selected enclosure.

1.1.1 Refrigeration cycle

In the refrigeration cycle, a heat pump transfers[11] heat from a lower-temperature heat source into a higher-temperature heat sink. Heat would naturally flow in the opposite direction. This is the most widely recognized sort of aerating and cooling.

A refrigerator works in much the same way, as it pumps the heat out of the interior and into the room in which it stands.

1.2 Refrigerants

"Freon" is a trade name for a family of haloalkane refrigerants[12] manufactured by DuPont and other companies. These refrigerants were commonly used due to their superior stability and safety properties. However, these chlorine-bearing refrigerants reach the upper atmosphere when they escape.[6] Once the refrigerant reaches the stratosphere, UV radiation from the Sun cleaves the chlorine-carbon bond, yielding a chlorine radical.

1.3 Condenser

A condenser or evaporator is a heat exchanger, permitting condensation, by method for radiating, or taking in heat separately.

The construction principle:

Refrigerant and air will be physically isolated, at aeration and cooling system condenser, and evaporator. Along these lines, heat exchange happens by method for conduction.

We might want the [2] heat exchanger that empowers these procedures, to have,

High conductivity– this property will guarantee that the low temperature distinction between the outside wall, and inside wall

High contact factor– this property guarantees the passing air mass, will interact with the tubes, however much as could be expected

We need to comprehend the components that impact conduction of a material. We should accept a condition where the refrigerant is inside of the tube[3] of an aeration and cooling system condenser. The tube will have a circular wall.

Fourier'slaw has stated that the rate of conduction heat transfer[2] is proportional to,

The thermal conductivity of the wall 'k' W/m^2

The mean surface area, A m^2

The inverse of the wall's thickness L in m

And the temperature difference between the inside wall, and the outside wall

Determination of the tube for the condenser and evaporator needs to meet couple of other criteria too. It must be solid, hard to oxidize, simple to join with

different lengths of comparable tube, great quality and modest.

Copper and aluminum has checked to meet all the criteria specified, with astounding thermal conductivity. Obviously it is not the best material with high thermal conductivity, but rather it is exceptionally modest for the execution. It infers that the rate of heat exchange will increment if the aggregate surface territory of the condenser or the evaporator is expanded.

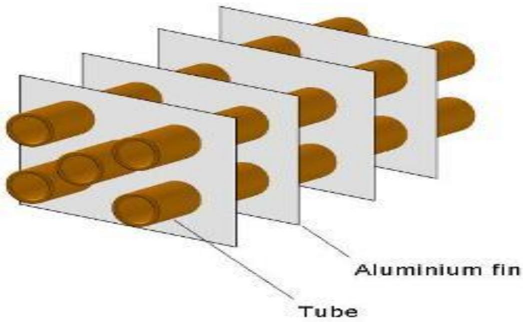

Fig 1.1 Fin-Tube Type Condenser

We run the tube into an arrangement of alluminium sheets. The tube will contact the sheets, and henceforth the surface range for conduction heat exchange is increased.[1] These blades will likewise serve as guide vanes for air to go through the tube set, and enhance the productivity.

Contact factor

It is the measure of media that should be warmed up or chilled off, that comes straightforwardly in contact with the tube walls [3]. Contact variable will be low, if the air inside a channel is gone through a straight tube with refrigerant. This happens as the measure of air that contacts the tube [1]

2. MODEL OF CONDENSER

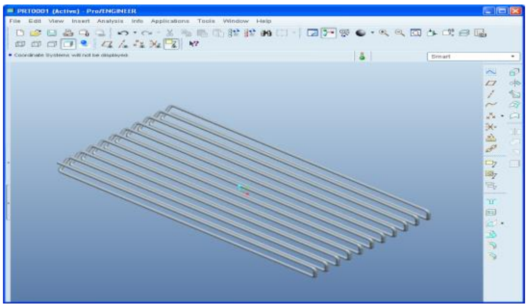

Fig 2.1 Tube

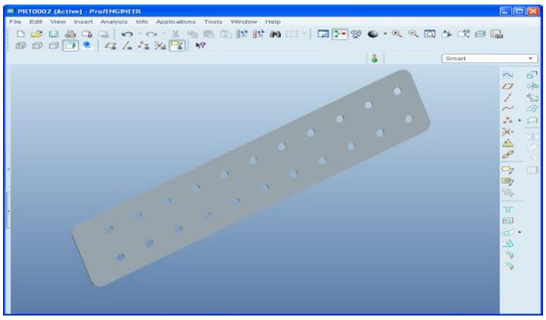

Fig 2.2 Plate

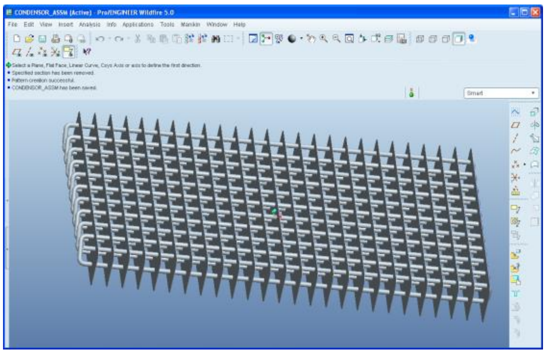

Fig 2.3 Assembly of Tube type Condenser

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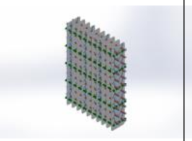
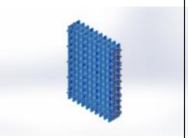
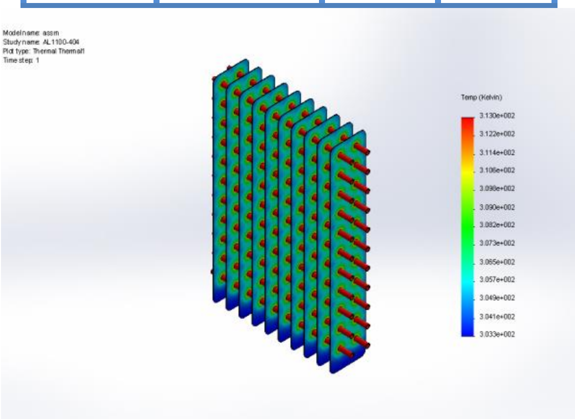
3.THE RMALAN ALYSIS AND OPTIMIZATION OF CONDENSOR

Table 3.1 Thermal Loads

Load name	Load Image	Load Details
Temperature-1		Entities : 22 face() Temperature: 313 Kelvin
Convection-1		Entities: 20 face(s) Convection Coefficient: 900 (W/m^2)/K Time variation: Off Temperature variation: Off Bulk Ambient Temperature: 303 Kelvin Time variation: Off

3.1 ALUMINUM ALLOY 1100- STUDY RESULTS

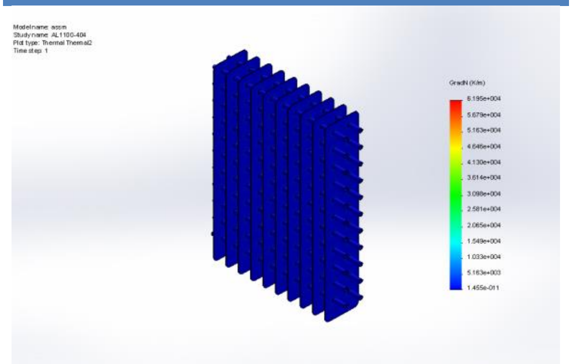
Name	Type	Min	Max
Thermal1	TEMP: Temperature	303.278 Kelvin Node: 13	313.034 Kelvin Node: 251945



assm-AL1100-404-Thermal-Thermal1

Fig3.1 Assembly-AL1100-404-Thermal-Thermal1

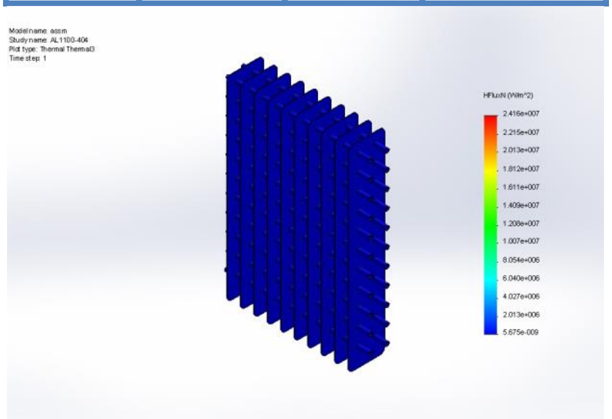
Name	Type	Min	Max
Thermal2	GRADN: Resultant Temp Gradient	1.45519e-011 K/m Node: 172658	61952.3 K/m Node: 277193



assm-AL1100-404-Thermal-Thermal2

Fig 3.2 Assembly-AL1100-404-Thermal-Thermal2

Name	Type	Min	Max
Thermal3	HFLUXN: Resultant Heat Flux	5.67525e-009 W/m^2 Node: 172658	2.41614e+007 W/m^2 Node: 277193



assm-AL1100-404-Thermal-Thermal3

Fig 3.3 Assembly-AL1100-404Thermal-Thermal3

3.2 ALUMINUM ALLOY 6063- STUDY RESULTS

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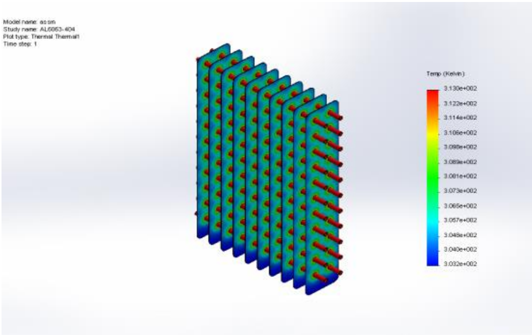
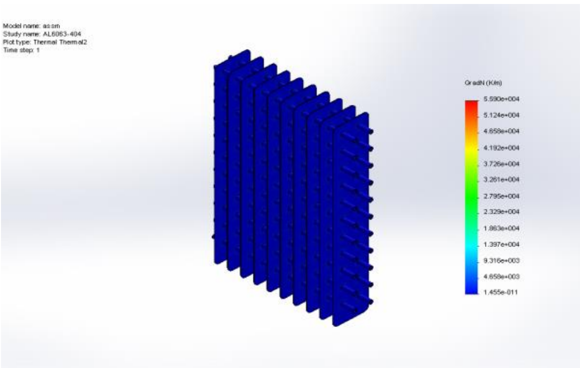
Name	Type	Min	Max
Thermal1	TEMP: Temperature	303.192 Kelvin Node: 13	313.031 Kelvin Node: 251945



assm-AL6063-404-Thermal-Thermal1

Fig3.4 Assembly-AL6063-404-Thermal-Thermal1

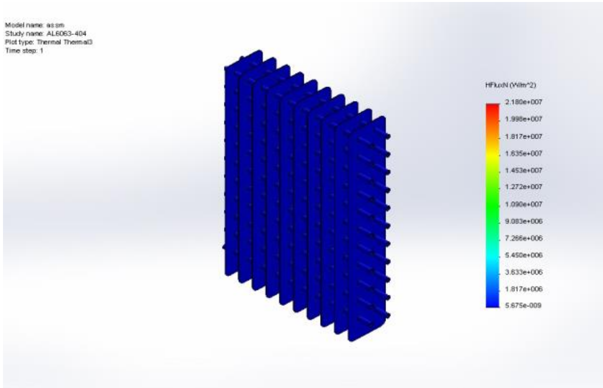
Name	Type	Min	Max
Thermal2	GRADN: Resultant Temp Gradient	1.45519e-011 K/m Node: 172658	55895.6 K/m Node: 277193



assm-AL6063-404-Thermal-Thermal2

Fig3.5:Assembly-AL6063-404-ThermalThermal2

Name	Type	Min	Max
Thermal3	HFLUXN: Resultant Heat Flux	5.67525e-009 W/m^2 Node: 172658	2.17993e+007 W/m^2 Node: 277193



assm-AL6063-404-Thermal-Thermal3

Fig3.6 Assembly-AL6063-404-Thermal-Thermal3

4. RESULTS

	R404	
	AL1100	AL6063
TEMP(K)	313	313
TG(K/m)	61952.3	55895.6
TF (W/m^2K)	2.41614e+007	2.17993e+007

5. CONCLUSION

In this paper, an AC condenser is outlined and upgraded for better material, refrigerant to enhance the heat transfer rate. Present utilized material for fin is Aluminum composite 204 and cooling liquid is R404. Modeling is done in Pro/Engineer

To enhance the condenser for best result, thermal analysis is done on the condenser. Examination is done utilizing blade materials Aluminum Alloy 1100, Aluminum Alloy 6063. Furthermore by changing the cooling liquid HCFC to R404.

By observing the thermal analysis results, utilizing fin material Aluminum alloy 1100, heat flux is more than other two materials. So by utilizing

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Aluminum composite 1100, the heat transfer rate increases with the refrigerant R404.

6. FUTURE SCOPE

In this paper, it is presumed that utilizing R404 as refrigerant more analyses should be possible. Furthermore more changes can be rolled out to improvement the state of the condenser to build the effectiveness.

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