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Performance Improvement of Design and Thermal Analysis of Air Conditioning System

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Abstract:
Air conditioning is the process of altering the properties of air (primarily temperature and humidity) to more favorable conditions. More generally, air conditioning can refer to any form of technological cooling, heating, ventilation, or disinfection that modifies the condition of air. It is a well-known fact that a large amount of heat energy associated with the exhaust gases from an engine is wasted. A rough energy balance of the available energy in the combustion of fuel in a motor car engine shows that one third is converted into shaft work, one third is lost at the radiator and one third is wasted as heat at the exhaust system. Even for a relative small car-engine, 15 kW of heat energy can be utilized from the exhaust gas. This heat is enough to power an absorption refrigeration system to produce a refrigeration capacity of 5 kW. Where thermal energy is available the absorption refrigerator can very well substitute than the vapour compression system.

An absorption refrigerator is a refrigerator that uses a heat source (e.g., solar, kerosene-fueled flame, waste heat from factories or district heating systems) to provide the energy needed to drive the cooling system. In this thesis, energy from the exhaust gas of an internal combustion engine is used to power an absorption refrigeration system to air-condition an ordinary passenger car. All the required parts for the absorption refrigeration system is designed and modeled in 3D modeling software SOLIDWORKS. Thermal analysis is done on the main parts of the refrigeration system to determine the thermal behavior of the system. Analysis is done in Ansys.

By observing the analysis results, total heat flux is more for aluminum alloy than remaining two materials for both condenser and evaporator. So using aluminum alloy is better.

I. INTRODUCTION:

II. AIR CONDITIONING:

Air conditioning (often referred to as aircon, AC or A/C) is the process of altering the properties of air (primarily temperature and humidity) to more favorable conditions. More generally, air conditioning can refer to any form of technological cooling, heating, ventilation, or disinfection that modifies the condition of air. An air conditioner is a major or home appliance, system, or mechanism designed to change the air temperature and humidity within an area (used for cooling and sometimes heating depending on the air properties at a given time). The cooling is typically done using a simple refrigeration cycle, but sometimes evaporation is used, commonly for comfort cooling in buildings and motor vehicles. In construction, a complete system of heating, ventilation and air conditioning is referred to as "HVAC".

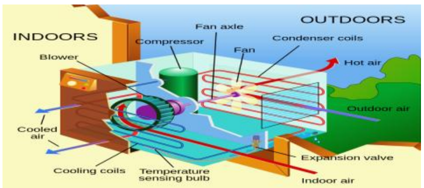


Figure: A typical home air conditioning unit

HISTORY:

The basic concept behind air conditioning is said to have been applied in ancient Egypt, where reeds were hung in windows and were moistened with trickling water. The evaporation of water cooled the air blowing through the window, though this process also made the air more humid (also beneficial in a dry desert climate). In Ancient Rome, water from aqueducts was circulated through the walls of certain houses to cool them. Other techniques in medieval Persia involved the use of cisterns and wind towers to cool buildings during the hot season. Modern air conditioning emerged from advances in chemistry during the 19th century, and the first large-scale electrical air conditioning was invented and used in 1902 by Willis Carrier. The introduction of residential air conditioning in the 1920s helped enable the great migration to the Sun Belt in the US. St George's Hall in Liverpool England, built between 1841 and 1854, was, in 2005, awarded a Blue Plaque by the Heritage Group of the CIBSE recognising it as the World's First Air Conditioned Building.

FINAL DIMENSIONS

Dimensions of the designed pre-heater

Outside Diameter of the tube, **D0 = 0.012 m**
Inside Diameter of the tube, **Dj = 0.01 m**
Length of the tube, **L =2m**

By using similar calculations also findout the Dimensions of the following Generator

It is the place where the exhaust gas tube is passed through the container and the tube emperature is assumed to be a constant.

Dimensions of the designed generator

Outside Diameter of the exhaust gas tube,
D0 = 0.04 **m**
Taking inside diameter of the exhaust gas tube, **Di** = 0.038**m**
Length of the tube required for the required heat transfer, **L= 1 m**

Condenser:

Assume circular cross section of the condenser coil of thickness, a = 5 mm &Diameter d = 18 mm.

Dimensions of the designed condenser

Diameter of the tube, **d = 0.018 m** Thickness of the tube, **a= 0.005 m** Length of the tube, L = 7**.45 m**

Evaporator

The evaporator is of circular cross section and should be made of copper tubes to have maximum heat transfer from the atmosphere to the refrigerant. The tube is coiled to accommodate it inside the automobile.

Dimensions of the designed evaporator

Outside Diameter of the tube, **D0** = 0.01 **m** Inside Diameterof the tube,
Dj - 0.008 **m** Length of the tube, L = **6.26 m**

Absorber

It is a container in the system which absorbs the refrigerant coming from the evaporator using the solution coming from the generator. Proper cooling should be provided as heat is liberated during the absorption process which should be done using air.

Dimensions of the designed absorber

Outside diameter of the absorber, D0 = 76 mm Total length of the absorber,
L = 205 mm Outer diameter of the fins,
Df= 109 mm ,No. of fins, n=7

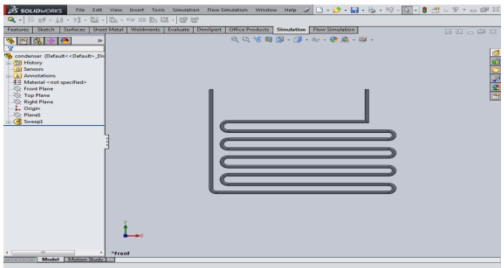
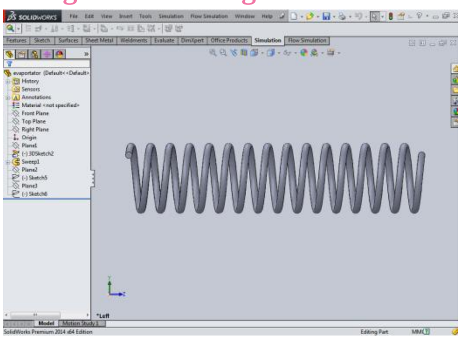


Figure: Modeling of condenser



Figurer: Modeling of Evaporator

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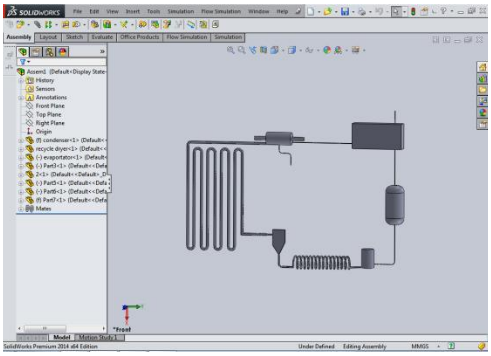

Figure : Assembly of air conditioning system

III. THERMAL ANALYSIS OF AIR CONDITIONING SYSTEM

Performing thermal analysis of condenser and evaporator to find out thermal flux and temperature gradient using two different materials such as aluminium alloy and copper .

Thermal analysis of condenser:

Material: Aluminum alloy

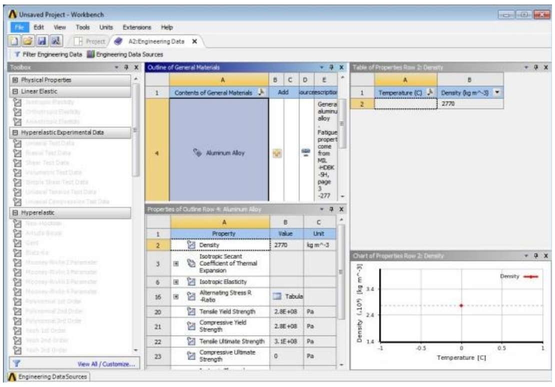

Figure: Aluminum alloy material properties

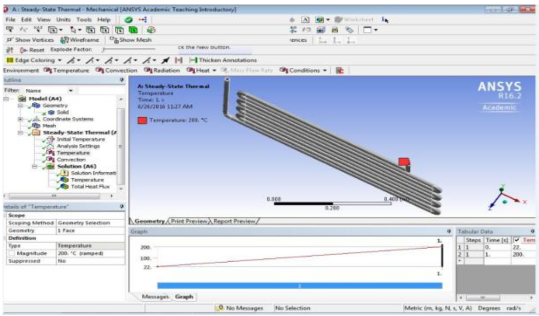

Figure : Input temperature

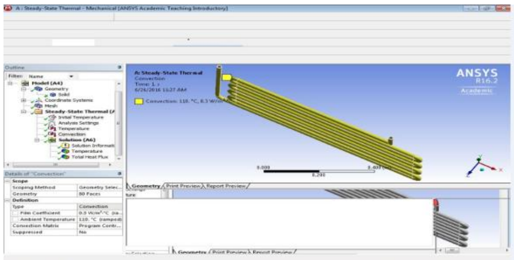

Figure: Convection

RESULTS:

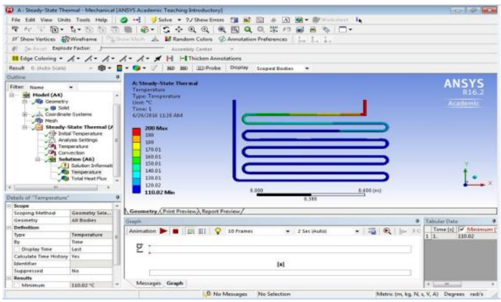

Figure: temperature distribution

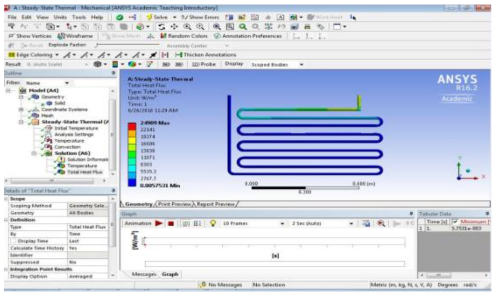

Figure: Total heat flux

Material: structural steel

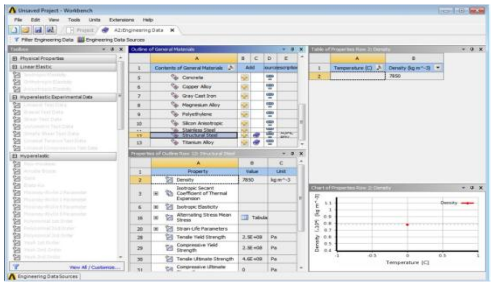

Figure: structural steel material properties

RESULTS:

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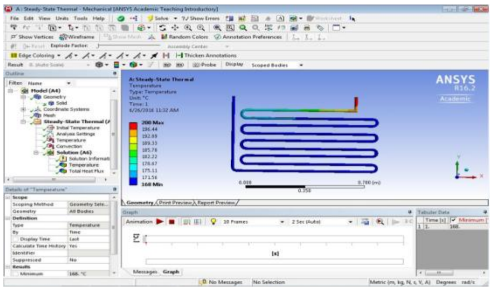

Figure: temperature distribution

Figure: Total heat flux

Material: Titanium Alloy

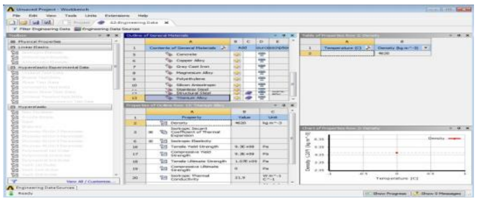

Figure: Titanium alloy material properties

RESULTS:

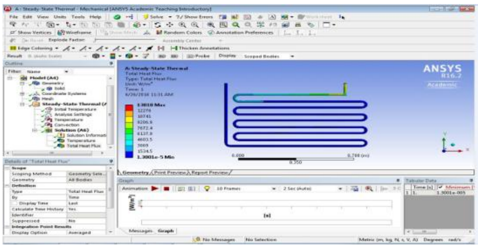

Figure: temperature distribution

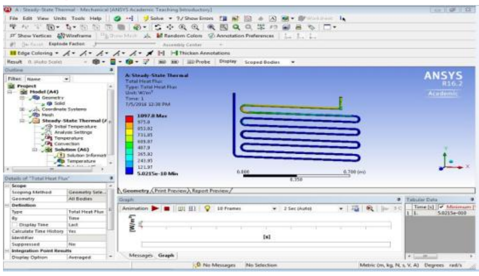

Figure: Total heat flux

Thermal analysis of evaporator
Material used : Aluminium Alloy

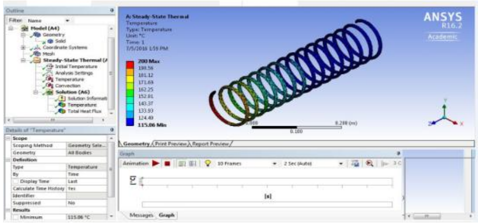

Figure: temperature distribution

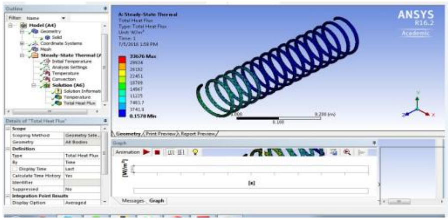

Figure: Total heat flux

Material: structural steel

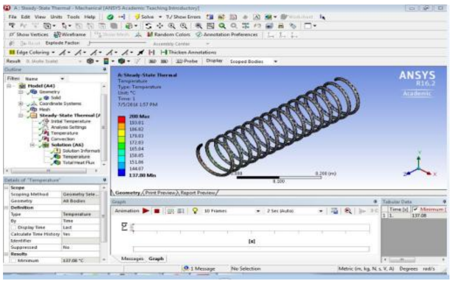

Figure: temperature distribution

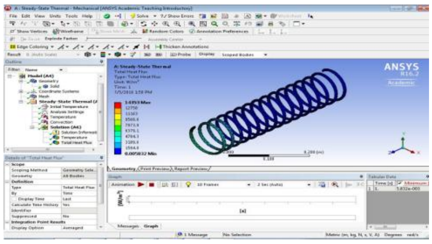

Figure: Total heat flux

Material: Titanium alloy

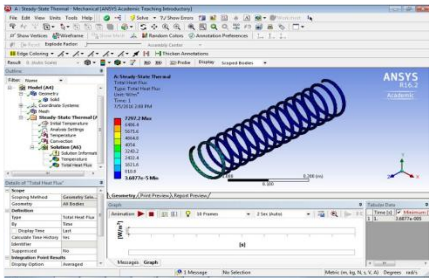

Figure: temperature distribution

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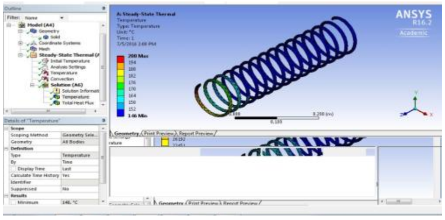

Figure: Total heat flux

IV. RESULTS AND DISCUSSIONS

ANALYSIS REPORT OF CONDENSER:

	ALUMIUM ALLOY	STRUCTURAL STEEL	TITANIUM ALLOY
TEMPERATURE DISTRIBUTION(deg centigrade)	110.2	168	153
TOTAL HEAT FLUX(W/m2)	24909	13810	1097.8

ANALYSIS REPORT OF EVAPORATOR:

	ALUMIUM ALLOY	STRUCTURAL STEEL	TITANIUM ALLOY
TEMPERATURE DISTRIBUTION(deg centigrade)	115.06	137.08	146
TOTAL HEAT FLUX(W/m2)	33676	14353	7297.2

V. CONCLUSIONS:

Thermal analysis was done in two main components i.e condenser & evaporator though the results obtained. This result will have to be improved for further development. It can be concluded that: i. For the working of vapour absorption refrigeration system generally achieved by burning the fuel in a separate combustion chamber and then supplying the Generator of a Vapour Absorption Refrigeration System with the products of its combustion to produce the required refrigerating effect. However this prospect is eliminated since it requires a separate fuel and a separate combustion chamber which makes it uneconomical and the system becomes inefficient.
ii. The above draws back will eliminated by utilizing the heat of combustion which is wasted into the atmosphere. By designing a generator capable of extracting the waste heat of an IC engine without any decrease in engine efficiency, a Vapour Absorption Refrigeration System can be brought to work. Since this arrangement does not require any extra work expect a small amount of work required for the pump, which can be derived from the battery, this system can be used in automobiles where engine efficiency is the primary consideration. iii. In this project SOLIDWORKS is used for the design of components & used ansys for the analysis iv. By observing the analysis results, total heat flux is more for aluminum alloy than remaining two materials for both condenser and evaporator. So using aluminum alloy is better.

REFERENCES

1. Anantha narayanan P N (2005) 'Refrigeration & Air Conditioning', Tata McGraw-Hill..3rdedition, pp.398 - 424.

2. Arora;Domkundwar. (2004) 'A course in Refrigeration & Air Conditioning', Dhanpat Rai & Co., 7thedition, pp.6.1- 6.23.

3. Lorentzen G. and Pettersen J. (1993) A New, Efficientand Environmentally Benign System for Car air-conditioning, International Journal Refrigeration, 161.

4. Arora C P (2002) 'Refrigeration & Air Conditioning', Tata McGraw Hill., 2nd edition, pp.301-314, 339 - 356,427 - 456.

5. Ballaney PL (2003),* Refrigeration & Air Conditioning' Khanna Publishers., 13th edition, pp. 483 - 542.

6. Domkundwar & Domkundwrar. (2005) 'Heat & Mass Transfer- Data Book', Dhanpat Rai & Co., 2nd edition,

7. Horuz I (August 1999), 'Vapor Absorption Refrigeration in Road Transport Vehicles', Journal of Energy Engrg., Volume 125, Issue 2, pp. 48-58.

8. Manohar Prasad. (2000) 'Refrigeration & Air Conditioning', New Age International Publishers., 3rd edition, pp. 188 - 225.

9. Manohar Prasad. (2000) 'Refrigeration & Air Conditioning - Data Book'. New Age International Publishers., 2nd edition.

10. Vicatos G. (1995) Heat and mass transfer characteristics: Design and optimisation of absorption refrigeration machines, PhD thesis, University of Cape Town South Africa.