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Design and Analysis of Absorption Refrigeration Air Conditioning System Used in Cars

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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 motorcar 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 vapor 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 CREO parametric software. 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.

I. INTRODUCTION

Refrigeration is the process of casting off warmth from an enclosed or controlled space, or from a substance, and transferring it to an area in which it is miles unobjectionable. The number one cause of refrigeration is lowering the temperature of the enclosed area or substance after which keeping that decrease temperature as evaluate to surroundings. Cold is the absence of heat, therefore on the way to lower a temperature, one "removes warmth", rather than "including cold." The basic objective of growing a vapor absorption refrigerant system for vehicles is to cool the distance inside the automobile through making use of waste heat and exhaust gases from engine. The air con gadget of motors in these day's world makes use of "Vapour Compression Refrigerant System" (VCRS) which absorbs and gets rid of heat from the interior of the car that's the space to be cooled and in addition rejects the heat to be somewhere else. Now to increase a performance of vehicle past a sure restriction vapour compression refrigerant device resists it because it cannot employ the exhaust gases from the engine. In vapour compression refrigerant machine, the machine makes use of electricity from engine shaft as the input electricity to force the compressor of the refrigerant device; subsequently the engine has to provide greater work to run the compressor of the refrigeration gadget using more amount of gasoline. This loss of electricity of the car for refrigeration may be left out via using another refrigeration machine i.e. A "Vapour Absorption Refrigerant System" i.E low-grade warmth operated structures. It is well known that an IC engine has an efficiency of about 35-forty%, which means that only one-0.33 of the energy within the gas is transformed into beneficial paintings and approximately 60-65% is wasted to environment. In which 28-30% is lost with the aid of cooling water and lubrication losses, round 30-32% is lost in the form of exhaust gases and the rest by way of radiation, andmany others.

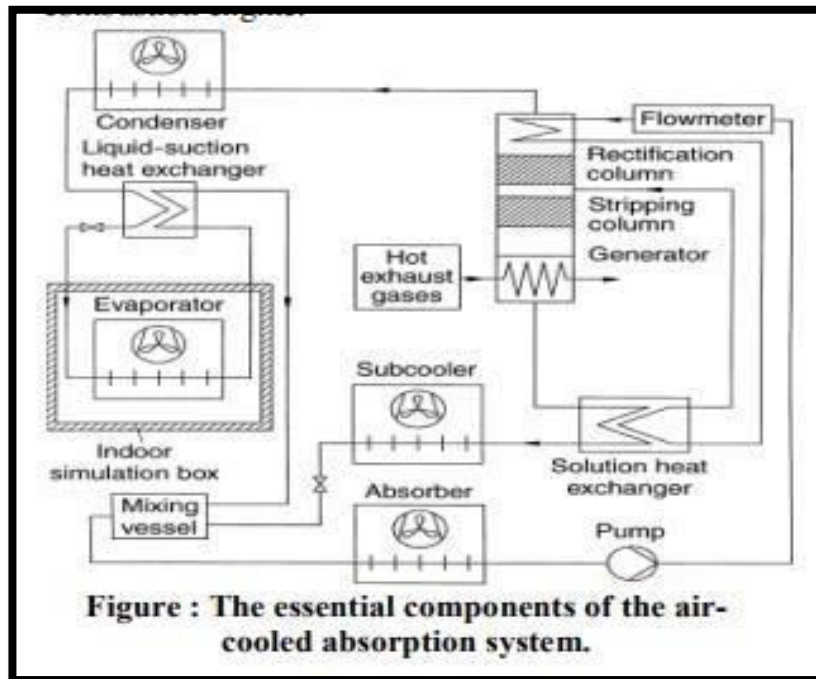


fig.1: The essential components of components of Air-cooled Absorption system

II. LITERATURE REVIEW

A Cooling System for an Automobile Based on Vapour Absorption Refrigeration Cycle Using Waste Heat of an Engine. Development of Vapour Absorption Refrigerant System For Cars (the use of Engine Heat) Absorption AC in Vehicles Using Exhaust Gas Development Of Air Conditioning System Based On Vapour Absorption Refrigeration Cycle For Automobiles Using Exhaust Gasses With R134a-Dmf the experimental work to make use of the waste warmth from exhaust gases from an engine for the vapour absorption refrigerant machine with R-134a as refrigerant and DMF as absorbent. The experimental consequences indicated that car performance enhances, noise reduces, renovation will become simpler, and tremendously dependable. The statistics received from experimentation is provided analyzed in this paper.

FINAL DIMENSIONS

Dimensions of the designed pre-heater Outside Diameter of the tube, $D_o = 0.012$ m Inside Diameter of the tube, $D_i = 0.01$ m Length of the tube, $L = 2$ m Dimensions of the designed generator

By using comparable calculations additionally findout the Dimensions of the Generator It is the place where in the exhaust gas tube is surpassed via the field and the tube Temperature is assumed to be a regular. Outside Diameter of the exhaust gas tube, $D_o = 0.04$ m

Taking interior diameter of the exhaust gasoline tube, $D_i = 0.038$ m Length of the tube required for the desired warmth switch, $L = 1$ m

Condenser:

Assume circular cross segment 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, $a = 0.1/2$ m Length of the tube, $L = 7.45$ m

Evaporator: The evaporator is of circular go segment and should be manufactured from copper tubes to have maximum heat switch from the environment to the refrigerant. The tube is coiled to accommodate it inside the car. Dimensions of the designed evaporator Outside Diameter of the tube, $D_o = 0.01$ m Inside Diameter of the tube, D_i



= 0.008 m Length of the tube, L = 6.26 m

Absorber: It is a container inside the device, which absorbs the refrigerant coming from the evaporator using the answer coming from the generator. Proper cooling ought to be provided as warmth is liberated throughout the absorption method that need to be completed using air.

Dimensions of the designed absorber

Outside diameter of the absorber, Do = 76 mm Total length of the absorber, L = 205 mm

Outer diameter of the fins, Df= 109 mm ,No. Of fins, n=7

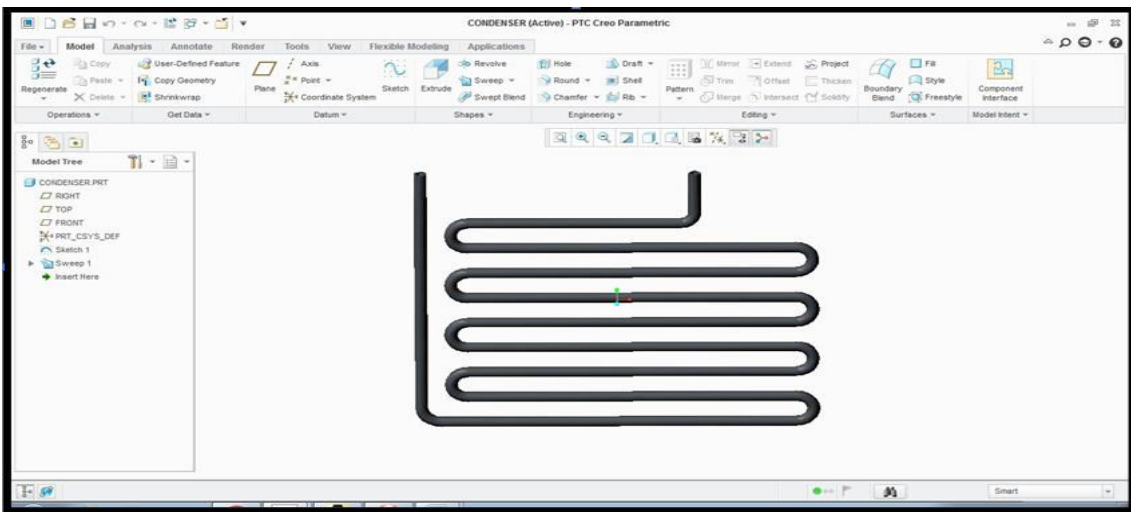
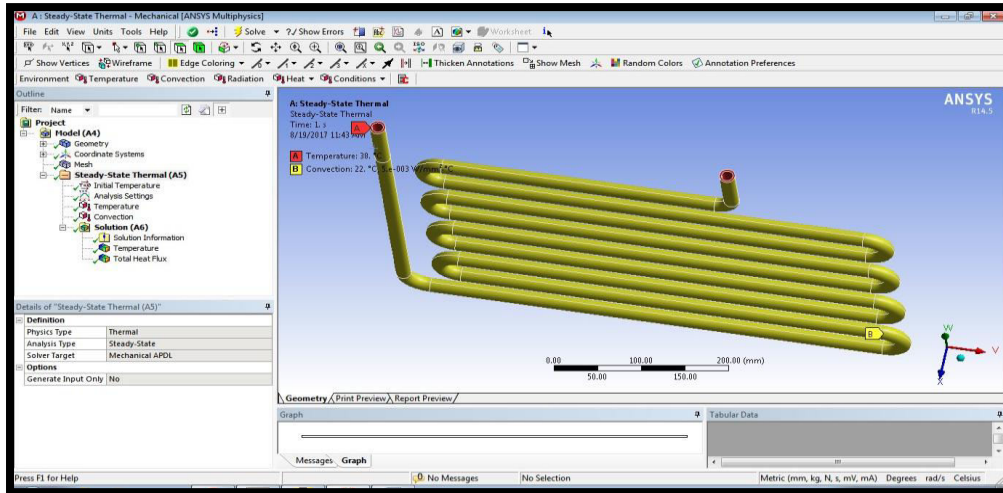


Fig: Creo model of Condenser

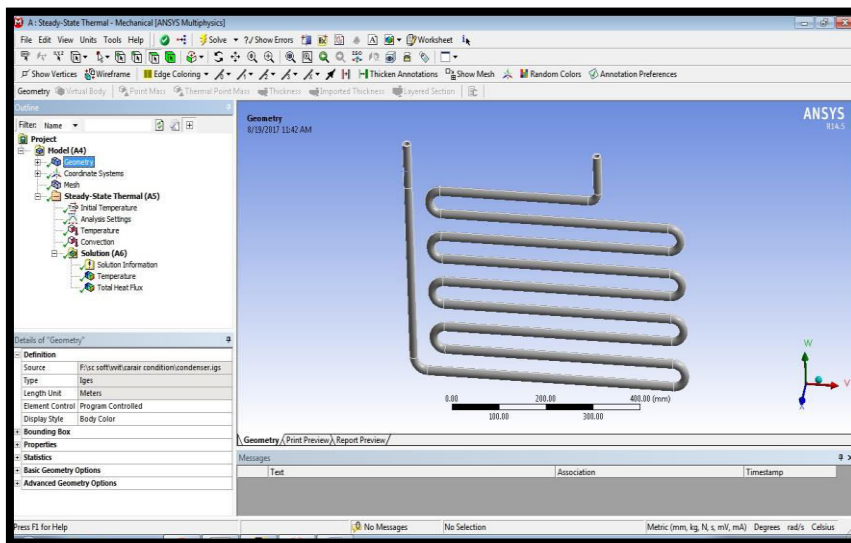
THERMAL ANALYSIS OF CONDENSER

Thermal Properties	Metric
CTE, linear	8.70 $\mu\text{m}/\text{m}^{\circ}\text{C}$ @Temperature 20.0 - 100 $^{\circ}\text{C}$
	9.20 $\mu\text{m}/\text{m}^{\circ}\text{C}$ @Temperature 20.0 - 250 $^{\circ}\text{C}$
	10.0 $\mu\text{m}/\text{m}^{\circ}\text{C}$ @Temperature 20.0 - 500 $^{\circ}\text{C}$
Specific Heat Capacity	0.525 J/g- $^{\circ}\text{C}$
Thermal Conductivity	7.00 W/m-K
Melting Point	1550 - 1600 $^{\circ}\text{C}$
Solidus	1550 $^{\circ}\text{C}$
Liquidus	1600 $^{\circ}\text{C}$

GEOMETRY MODEL



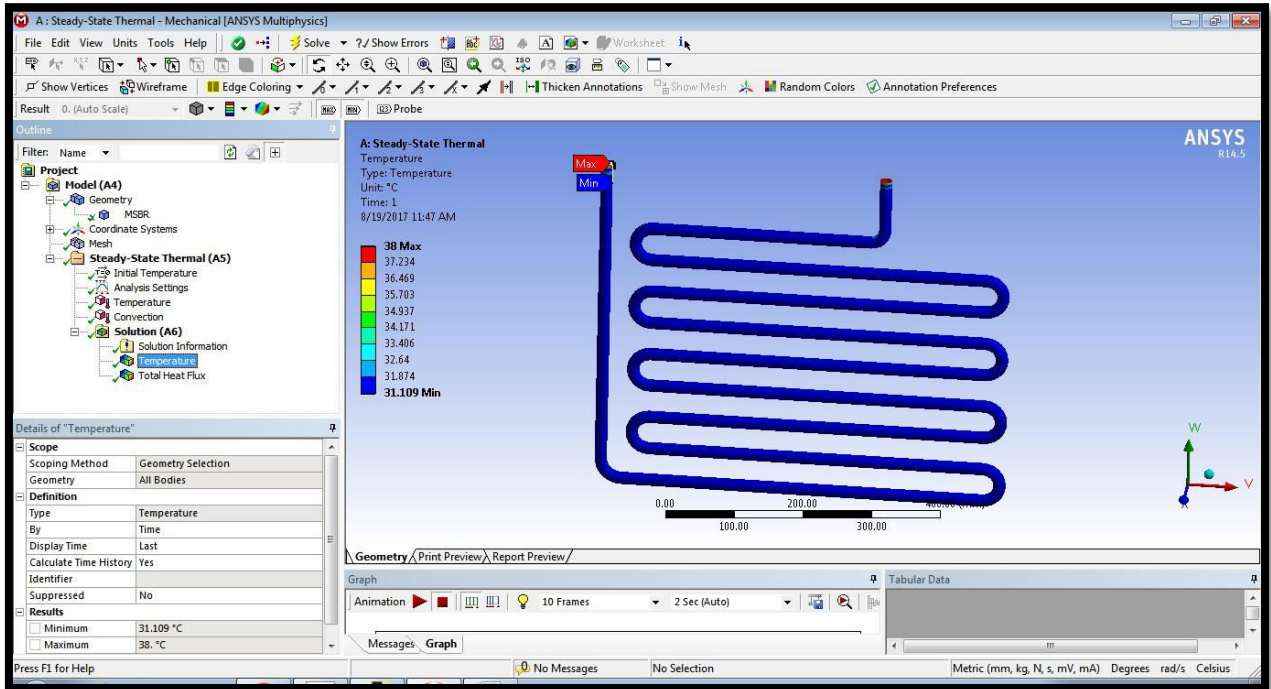
MESHED MODEL



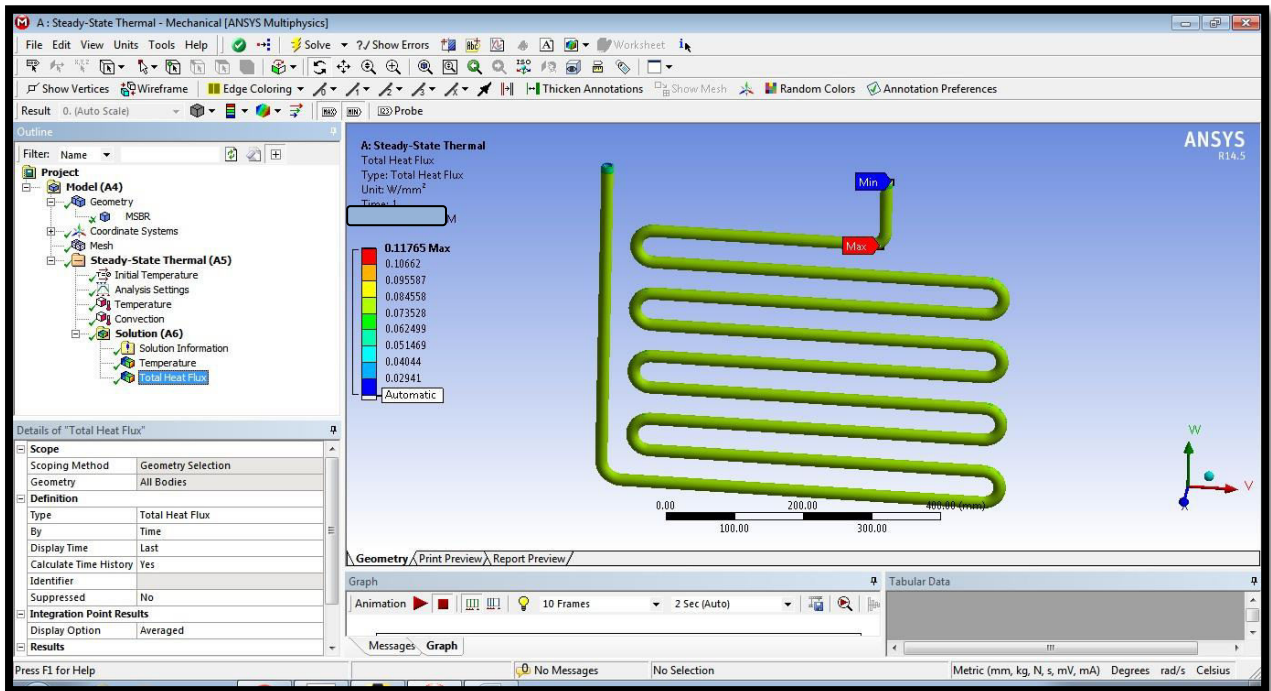
BOUNDARY CONDITIONS

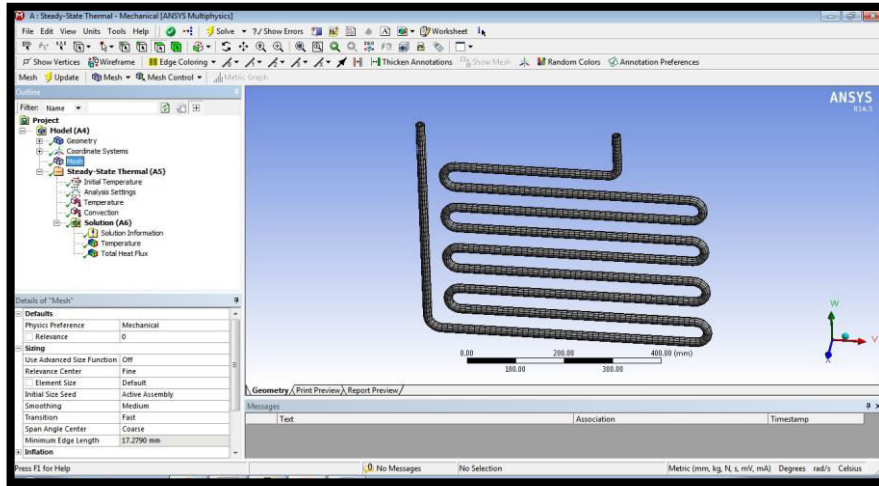


TEMPERATURE DISTRIBUTION



HEATFLUX





III. RESULT AND DISCUSSION CONDENSER

Fluids	Materials	Temperature(⁰ C)		Heatflux(w/mm ²)
		Max.	Min.	
Water	steel	38	34.714	0.097461
	Aluminum alloy	38	36.529	0.11095
	copper	38	37.41	0.11765
	Titanium alloy	38	31.109	0.071858
R134A	steel	38	32.828	0.15101
	Aluminum alloy	38	35.312	0.186044
	copper	38	36.969	0.20571
	Titanium alloy	38	28.473	0.097288

Models	Fluids	Pressure drop(Pa)	Velocity (m/s)	Heat transfer coefficient (w/m ² -k)	Mass flow rate(kg/s)	Heat transfer rate (W)
Condenser	Water	1.32E+06	2.47E+01	6.78E+04	0.03262615	10214.063
	R134A	5.74E+03	2.49E+01	3.69E+02	0.00012859	9.7034912



Evaporator	Water	3.68E+06	2.30E+01	7.48E+04	0.01999718	6262.4688
	R134A	2.13E+04	2.20E+01	4.47E+02	0.00014976	11.298492

IV. CONCLUSION

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 vapor absorption refrigeration system generally achieved by burning the fuel in a separate combustion chamber and then supplying the Generator of a Vapor 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 Vapor 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 CREO parametric software is used for the design of components & used ANSYS for the analysis

IV. By observing the analysis results, total heat flux is more for copper than remaining three materials for both condenser and evaporator. So using copper is better.

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