DESIGN OF A CAR AC SYSTEM BASED ON ABSORPTION REFRIGERATION CYCLE USING ENERGY FROM EXHAUST GAS OF AN IC ENGINE

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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 CREO parametric software and using different materials 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.

INTRODUCTION

Refrigeration is the process of casting off warmness from an enclosed or controlled

space, or from a substance, and transferring it to an area in which it's 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 warmness", rather than "including cold." The basic objective of growing a vapour 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 days'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 an performance of vehicle past a sure restriction vapour compression refrigerant device resists it because it can't 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, and many others. In a Vapour Absorption Refrigerant System, a physicochemical manner replaces the mechanical process of the Vapour Compression Refrigerant System via the usage of electricity in the form of heat in place of mechanical work.

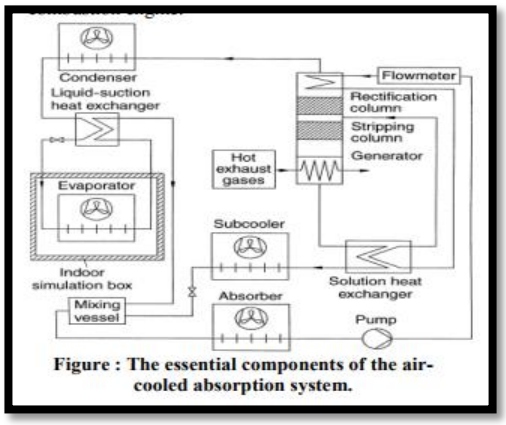


Figure : The essential components of the air-cooled absorption system.

LITERATURE REVIEW

1. A Cooling System for an Automobile Based on Vapour Absorption Refrigeration Cycle Using Waste Heat of an Engine.

Now a days the air conditioning device of motors is specifically uses "Vapour Compression Refrigerant System" (VCRS) which absorbs and removes warmness from

the indoors of the automobile this is the gap to be cooled and rejects the warmth to surroundings. In vapour compression refrigerant machine, the system makes use of strength from engine shaft as the input strength to force the compressor of the refrigeration system, consequently the engine has to produce extra work to run the compressor of the refrigerating machine utilising more quantity of gas. This lack of power of the automobile for refrigeration may be left out with the aid of using some other refrigeration device i.E. A "Vapour Absorption Refrigerant System". As widely known aspect approximately VAS that those machines required low grade power for operation. Hence in such varieties of machine, a physicochemical manner replaces the mechanical manner of the Vapour Compression Refrigerant System via using power inside the shape of heat rather than mechanical work. This warmness received from the exhaust of excessive strength inner combustion engines. Keywords: Waste heat from I. C. Engine, Waste heat healing machine for I. C. Engine, car air-conditioning, absorption refrigeration, renewable energy.

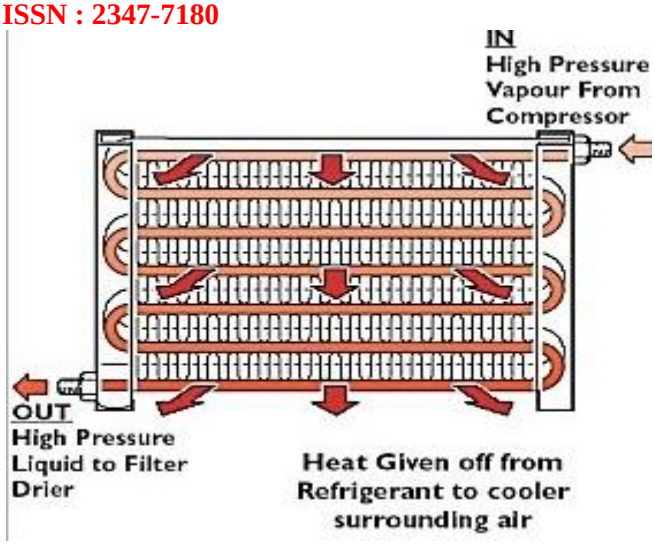
Development Of Vapour Absorption Refrigerant System For Cars (the use of Engine Heat))

The fundamental goal of developing a vapour absorption refrigerant gadget for motors is to chill the gap within the car by using utilizing waste warmth and exhaust gases from engine. The air conditioning system of motors in today's global uses "vapour compression refrigerant machine" (vcrs) which absorbs and gets rid of warmth from the indoors of the auto that's the distance to be cooled and finally rejects the warmth to be elsewhere. Now to boom an efficiency of vehicle past a sure limit vapour compression refrigerant system resists it because it cannot employ the exhaust gases from the engine.

COMPONENTS OF AIR COOLED ABSORPTION SYSTEM

1.CONDENSER

In systems concerning heat switch, a condenser is a tool or unit used to condense a substance from its gaseous to its liquid nation, by using cooling it. In so doing, the latent warmth is given up via the substance and transferred to the encircling environment. Condensers may be made in keeping with numerous designs, and are available in many sizes starting from instead small (hand held) to very large (business-scale devices utilized in plant processes). For example, a fridge uses a condenser to do away with heat extracted from the indoors of the unit to the out of doors air. Condensers are used in air con, commercial chemical tactics along with distillation, steam energy plants and different heat-change systems. Use of cooling water or surrounding air because the coolant is common in lots of condensers.



II.EVAPORATOR

An evaporator is a tool in a system used to turn the liquid form of a chemical substance inclusive of water into its gaseous-form/vapor. The liquid is evaporated, or vaporized, right into a gas form of the centered substance in that system.

Uses

One kind of evaporator is a form of radiator coil used in a closed compressor driven move of a liquid coolant. That is known as an air-conditioning device (A/C) or refrigeration gadget to allow a compressed cooling chemical, inclusive of R-22 (Freon) or R-410A, to evaporate/vaporize from liquid to fuel within the machine whilst soaking up heat from the enclosed cooled region, as an instance a fridge or rooms interior, within the system. This works within the closed A/C or refrigeration device with a condenser radiator coil that exchanges the heat from the coolant, which include into the ambient environment.

III. ENERGETIC:

Water may be removed from answers in approaches aside from evaporation, along with membrane processes, liquid-liquid extractions, crystallization, and precipitation. Evaporation can be distinguished from a few other drying techniques in that the very last made of evaporation is a concentrated liquid, now not a solid. It is also quite easy to apply and apprehend because it has been extensively used on a large scale, and many techniques are normally widely recognized. In order to concentrate a product by using water elimination, an auxiliary segment is used which lets in for clean transport of the solvent (water) in place of the solute. Water vapor is used as the auxiliary phase when concentrating non-volatile components, inclusive of proteins and sugars. Heat is added to the solution, and part of the solvent is transformed into vapor. Heat is the main device in evaporation, and the system occurs greater readily at excessive temperature and occasional pressures.

THERMAL ANALYSIS OF CONDENSER

Now a days the air conditioning system of cars is mainly uses “Vapour Compression Refrigerant System” (VCRS) which absorbs and removes heat from the interior of the car that is the space to be cooled and rejects the heat to atmosphere. In vapour compression refrigerant system, the system utilizes power from engine shaft as the input power to drive the compressor of the refrigeration system, hence the engine has to produce extra work to

run the compressor of the refrigerating system utilizing extra amount of fuel. This loss of power of the vehicle for refrigeration can be neglected by utilizing another refrigeration system i.e. a “Vapour Absorption Refrigerant System”. As well known thing about VAS that these machines required low grade energy for operation.

Use the thermal analysis heat from internal combustion engine determine the performance and emissions Temperature of an exhaust gas in kirloskar engine by an heat balance on engine by using electrical loading. Fuel used in engine is high speed diesel. Exhaust gas temperature range is varied depends upon the type and also amount load acting on the engine.

Used materials

Steel

Thermal Properties	Metric
CTE, linear	7.02 - 21.1 µm/m-°C
Specific Heat Capacity	0.200 - 0.620 J/g-°C
Thermal Conductivity	2.02 - 34.3 W/m-K
Melting Point	1230 - 1530 °C
Solidus	1230 - 1480 °C
Liquidus	1360 - 1530 °C
Maximum Service Temperature, Air	120 - 1400 °C
Minimum Service Temperature, Air	-200 - -34.0 °C

Aluminum alloy

Thermal Properties	Metric
Heat of Fusion	386.9 J/g
Heat of Vaporization	9462 J/g
CTE, linear	24.0 µm/m-°C @Temperature 20.0 - 100 °C 25.5 µm/m-°C @Temperature 20.0 - 300 °C 27.4 µm/m-°C @Temperature 20.0 - 500 °C
Specific Heat Capacity	0.900 J/g-°C
Thermal Conductivity	210 W/m-K
Melting Point	660.37 °C
Boiling Point	2519 °C

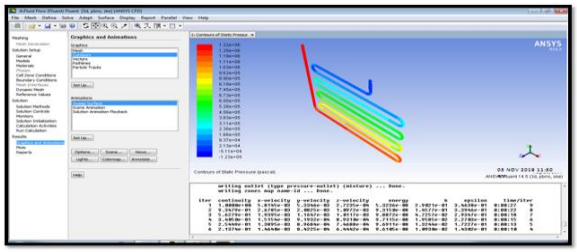
Copper

Thermal Properties	Metric
Heat of Fusion	204.8 J/g
Heat of Vaporization	5234 J/g
CTE, linear	16.4 µm/m-°C @Temperature 20.0 - 100 °C 18.5 µm/m-°C @Temperature 250 °C 20.2 µm/m-°C @Temperature 500 °C 24.8 µm/m-°C @Temperature 925 °C
Specific Heat Capacity	0.385 J/g-°C
Thermal Conductivity	385 W/m-K 357 W/m-K @Temperature 727 °C 398 W/m-K @Temperature 27.0 °C 401 W/m-K @Temperature 0.000 °C 483 W/m-K @Temperature -173 °C 10500 W/m-K @Temperature -253 °C 19600 W/m-K @Temperature -263 °C
Melting Point	1083.2 - 1083.6 °C
Boiling Point	2562 °C

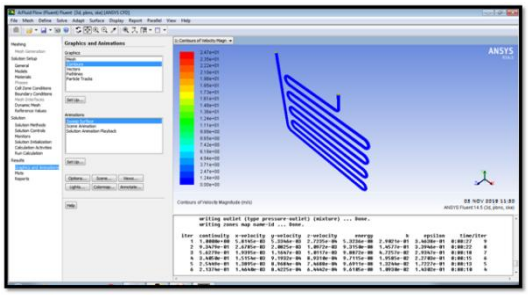
CFD ANALYSIS OF CONDENSER

FLUID- WATER

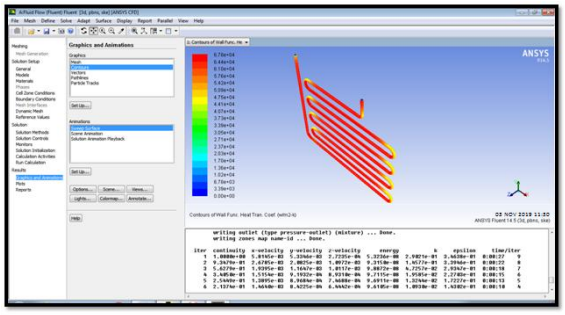
PRESSURE DROP



VELOCITY



HEAT TRANSFER COEFFICIENT



MASS FLOW RATE &HEAT TRANSFER RATE

Mass Flow Rate	(kg/s)
inlet	2.6064684
interior-____msbr	-6807.0132
outlet	-2.6390946
wall-____msbr	0
Net	-0.032626152

Total Heat Transfer Rate	(w)
inlet	815883.56
outlet	-826097.63
wall-____msbr	0
Net	-10214.063

CONCLUSION

IN THIS PAPER, 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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