DESIGN OF ABSORPTION REFRIGERATION SYSTEM DRIVEN BY ENGINE EXHAUST GAS FOR VEHICLES

[1] Dr. M. Sivakumar, [2] Dr. V. Venugopal, [3] Dr. G. Mahesh, [4] Dr. Karthikeyan P,
[1]Professor, Dept. of Mechanical Engineering, Malla Reddy College of Engineering, Sec-100
[2] Professor, Department of Mechanical Engineering, Malla Reddy College of Engineering, Sec-100
[3] Associate Professor, Department of Mechanical Engineering, Malla Reddy College of Engineering, Sec-100
[4] Professor,Department of Mechanical Engineering, Malla Reddy College of Engineering, Sec-100

Abstract— As we tend to all recognize that absorption refrigeration has no moving elements, Air conditioning is that the method of sterilisation the properties of air (primarily temperature and humidity) to additional favorable onditions. additional usually, air con will talk to any style of technological cooling, heating, ventilation, or medical care that modifies the condition o air. it's a widely known indisputable fact that an outsized quantity of warmth energy related to the exhaust gases from Associate in Nursing engine is wasted.

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.

Keywords—refrigeration, vapour, absorption, refigerent,CAD,CREO

I. 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. The heat required for running the Vapour Absorption Refrigeration System can be obtained from that which is wasted into the atmosphere from an IC engine. G. Vicatos[4] observed that in the exhaust gases of motor vehicles, there is enough heat energy that can be utilized to power an air conditioning system. Once a secondary fluid such as water or glycol is used, the aqua ammonia combination appears to be a good candidate as a working fluid for an absorption car air conditioning system. In the paper, the waste heat from gas engine turbine can be used as the heat source for the absorption refrigeration system. The experimental analysis showed that performance of the integrated

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refrigerating system was greatly improved by using the waste heat of gas engine. Colbourne [5] summarized a study analyzing over 50 published technical documents comparing the performance of fluorinated refrigerants and HCs. A significantly higher number of tests showed an increase in performance when using HCs as compared to using fluorinated refrigerants (Colbourne and Suen,)[6].Similarly, Colbourne and Ritter[7] investigated the compatibility of non-metallic materials with HC refrigerant and lubricant mixtures. They performed experiments in compliance with European standards for the testing of elastomeric materials and ASHRAE material compatibility test standards. Setaro et al. [8] tested and compared the heat transfer and pressure drop through a brazed plate heat exchanger and a tube-andfin coil for two different refrigerants, R22 and R290 in an air-to water heat pump system. Qin et al. [9] developed an exhaust gasdriven automotive air conditioning working on a new hydride pair. The results showed that cooling power and system coefficient of performance increase while the minimum refrigeration temperature decreases with growth of the heat source temperature. System heat transfer properties still needed to be improved for better performance. Koehler et al. [10] designed, built and tested a prototype of an absorption refrigeration system for truck refrigeration using heat from the exhaust gas. The refrigeration cycle was simulated by a computer model and validated by test data.

II.COMPONENTS OF AIR COOLED ABSORPTION SYSTEM INTRODUCTION TO CAD AND CREO

The components are condenser,evaporator in tis paper we are designing the condenser and evaporator for that we used cad and creo.

S.N	Engine Type	Power Output (kW)	Waste Heat
1.	Small air cooled diesel engine	35	30-40 % of energy waste loss from IC engines
2.	Water air cooled engine	35-150	
3.	Earth moving machineries	520-720	
4.	Marine applications	150-220	
5.	Trucks and road engines	220	

A. INTRODUCTION TO CAD

Computer-aided layout (CAD) is using laptop structures (or workstations) to useful resource within the creation, change, evaluation, or optimization of a layout. CAD software is used to increase the productivity of the fashion designer, enhance the best of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often within the form of digital files for print, machining, or other production operations. The time period CADD (for Computer Aided Design and Drafting) is also used.

Its use in designing digital systems is referred to as electronic design automation, or EDA. In mechanical layout it's far referred to as mechanical design automation (MDA) or computer-aided drafting (CAD), which incorporates the technique of creating a technical drawing with using pc software program.

CAD software for mechanical layout uses either vector-based totally photos to depict the objects of conventional drafting, or might also produce raster portraits showing the overall appearance of designed items. However, it includes greater than simply shapes. As inside the manual drafting of technical and engineering drawings, the output of CAD need to bring statistics, along with substances, approaches, dimensions, and tolerances, consistent with application-unique conventions.

CAD may be used to design curves and figures in two-dimensional (2D) area; or curves, surfaces, and solids in 3-dimensional (3D) space.

B. INTRODUCTION TO CREO

PTC CREO, previously known as Pro/ENGINEER, is 3-d modeling software utilized in mechanical engineering, design, production, and in CAD drafting carrier firms. It changed into one of the first 3D CAD modeling applications that used a rule-primarily based parametric gadget. Using parameters, dimensions and features to capture the behavior of the product, it could optimize the improvement product as well as the layout itself.

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The name become changed in 2010 from Pro/ENGINEER Wildfire to CREO. It become introduced by using the company who evolved it, Parametric Technology Company (PTC), all through the launch of its suite of design products that consists of programs inclusive of assembly modeling, 2D orthographic perspectives for technical drawing, finite detail analysis and more.

PTC CREO says it can provide a more efficient layout experience than different modeling software program due to its unique functions such as the mixing of parametric and direct modeling in one platform. The entire suite of applications spans the spectrum of product development, giving designers alternatives to apply in every step of the manner. The software also has a greater user friendly interface that provides a better revel in for designers. It also has collaborative capacities that make it clean to proportion designs and make changes.

There are limitless advantages to using PTC CREO.

We'll check them in this -component series.

First up, the largest advantage is improved productiveness due to its green and flexible design competencies. It changed into designed to be less difficult to use and have functions that allow for design procedures to transport more quickly, making a designer's productivity degree increase.

A particular feature is that the software program is available in 10 languages. PTC is aware of they have people from all around the world the usage of their software program, so they offer it in multiple languages so almost all people who wants to use it is able to achieve this.

C. ADVANTAGES OF CREO PARAMETRIC SOFTWARE

1. Optimized for model-based totally organizations

2. Increased engineer productivity

3. Better enabled concept layout

four. Increased engineering competencies

five. Increased manufacturing talents

6. Better simulation

7. Design abilties for additive manufacturing

D. CREO parametric modules:

- Sketcher
- Part modeling
- Assembly
- Drafting

E. 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 comparable calculations additionally findout the

Dimensions of the following Generator

It is the place wherein the exhaust gas tube is surpassed via the field and the tube emperature is assumed to be a regular.

Dimensions of the designed generator

Outside Diameter of the exhaust gas tube,

D0 = zero.04 m

Taking interior diameter of the exhaust gasoline tube, Di =

zero.038m

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.Forty five 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, D0 = zero.01 m Inside

Diameterof the tube,

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

Absorber
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

III. WORKING PRINCIPLE

Absorption cycles produce cooling and/or heating with thermal input and minimal electric input, by using heat and mass exchangers, pumps and valves. The absorption cycle is based on the principle that absorbing ammonia in water causes the vapor pressure to decrease. The basic operation of an ammonia-water absorption cycle is as follows. Heat is applied to the generator, which contains a solution of ammonia water, rich in ammonia. The heat causes high pressure ammonia vapor to absorb the solution. Heat can either be from combustion of a fuel such as clean-burning natural gas, or waste heat from engine exhaust, other industrial processes, solar heat, or any other heat source. The high pressure ammonia vapor flows to a condenser, typically cooled by outdoor air. The ammonia vapor condenses into a high pressure liquid, releasing heat which can be used for product heat, such as space heating. The high pressure ammonia liquid goes through a restriction, to the low pressure side of the cycle. This liquid, at low pressures, boils or evaporates in the evaporator. This provides the cooling or refrigeration product. The low pressure vapor flows to the absorber, which contains a water-rich solution obtained from the generator. This solution absorbs the ammonia while releasing the heat of absorption. This heat can be used as product heat or for internal heat recovery in other parts of the cycle, thus unloading the burner and increasing cycle efficiency. The solution in the absorber, now once again rich in ammonia, is pumped to the generator, where it is ready to repeat the cycle [13].

Vapour absorption refrigeration device

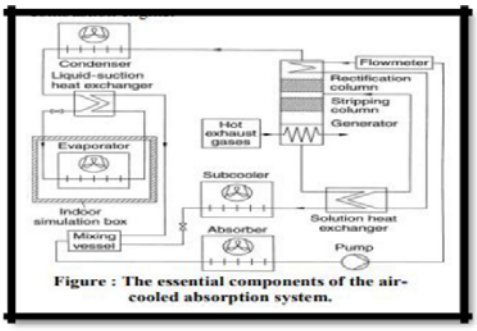


Figure : The essential components of the air-cooled absorption system.

1.	Engine Make	Kirloskar
2.	Engine Type	Single Cylinder
3.	Power	3.7 kW
4.	Speed	1500 rpm
5.	Bore Diameter	80 mm
6.	Stroke Length	110 mm
7.	Room Temperature	29 ℃
8.	Exhaust Gas	125℃ to 260℃

IV. LITERATURE REVIEW

Li-Ting Chen, 1988, Modified ejector-absorber absorption refrigeration cycle is presented and analyzed. From the results it is observed that a considerable improvement in COP is obtained with the present cycle when compared with that of the conventional cycle[1] .

George Vicatos, 1995, The author studied the absorption refrigeration system and Heat and Mass correlation and simulate the system and then designed the system. This study has developed a methodology which could be adopted in designing an absorption refrigeration plant, given a refrigeration requirement[2] .

Shiyi Wang, 1996, In this thesis S Wang designed the system, simulated it at different loads, manufactured it, carried out bench test and road test. In the exhaust gases of motor vehicles, there is enough heat energy which can be utilized to power an air-conditioning system “free” from any energy requirements [3].

P. Srikhirin et al., 2001, This paper provided a literature review on absorption refrigeration technology. A doubleeffect absorption systems using lithium bromide/water seem to be the only high performance system which is available commercially [4].

J Gryzagoridis et al.,2008, The theoretical design is verified by a unit that is tested under both laboratory and road-test conditions. The evaluation of the COP, with and without the heat exchanger also proves that unless there is a high purity refrigerant, the effect of the heat exchanger to the generator’s heat is small [5].

Andre Aleixo Manzela et al., 2010, This work presented an experimental study of an ammonia-water absorption refrigeration system using the exhaust of an internal combustion engine as energy source. Overall, carbon monoxide emission was decreased when the absorption refrigerator was installed in the exhaust gas, while hydrocarbon emissions increased [6].

Khaled S. AlQdah, 2011, This work presented an experimental study of an aqua-ammonia absorption system used for automobile air conditioning system. It is evident that COP strongly

depends on working conditions such as generator, absorber, condenser and evaporating the of temperature [7].

Isaac Mathew Pavoodath, 2012, In this paper study of absorption refrigeration is done. Such a system would vastly help take of the compressor load of the vehicle engine and would prove a great percentile of power saving for small capacity engines [8].

Christy V Vazhappilly et al., 2013, A breadboard prototype of an absorption system for refrigeration using heat from the exhaust-gases is to be designed, built and tested. The heating coil generator system of absorption refrigeration system has been replaced by plate frame type heat exchanger, there by utilizing the exhaust gases of the IC engine [9].

Janardhanan.k et al., 2014, This work presented a theoretical study of an aqua-ammonia absorption system used for automobile air conditioning system. Using a vapor absorption refrigeration system within an automobile as an air conditioner will not only reduce the fuel consumption of the vehicle while working but will also reduce the environmental pollution [10].

S. Manoj prabhakar et al., 2014, This work presented an experimental study refrigeration system, using vapor absorption system. The coefficient of performance of the system is low, that means that the system is expected to use a lot of energy with respect to the cooling it offers [11].

J.P. Yadav et al., 2014, In this paper study of an experimental set up is designed and fabricated. Using heat exchangers, analyzer, and pre-heater the COP of the system further improves. Even by using two evaporators the effectiveness of the system can be increased [12].

Paul Cedric Agra et al., 2014, This paper simulated the performance of the system using waste heat, a Bunsen burner was used which was attached to a propane tank via a rubber hose with a regulator. The small scale model with maximum COP 0.3685 at evaporator temperature 28 degree Celsius was achieved. In order to improve the performance of the system it is suggested to use high concentration of aqua ammonia solution [13].

S. Thanga mohan raja et al., 2015, In this paper study of ab- sorption refrigeration is done. The waste heat energy available in exhaust gas is directly proportional to the engine speed and exhaust gas flow rate [14].

Tambe. Y.D et al., 2015, In this paper the more focus was given to the design and manufacturing of the system with 80 cc internal combustion petrol engine. The experiments conducted on the system, prove that the concept is feasible and could be used for refrigeration in traction and non traction application of engine [15].

K L Rixon et al., 2015, In this paper study, design and fabrication of absorption refrigeration is done and result are obtained accordingly. Using a vapor absorption refrigeration system within an automobile as an air conditioner will not only reduce the fuel consumption of the vehicle but will also provide many other advantages like the efficiency of the engine is not decreased considerably [16].

N. Chandana reddy et al., 2015, In this paper, an overview of utilization of waste heat with a brief literature of the current related research is studied. A maximum power consumption of 42.38 percent is saved using proposed system compared to existing system [17].

Atishey Mittal et al., 2015, In this paper study of comparison of absorption refrigeration and compression refrigeration sys- tem is done. Waste heat recovery system is the best way to recover waste heat and saving the fuel [18].

Dinesh Chandrakar et al., 2016, In this paper designing of absorption refrigeration is done and results are obtained. As power output increase, the heat recovered from exhaust gas also increase difficulty may occur when the vehicles at rest or in very slow moving traffic conditions [20].

V.GAPS IDENTIFIED

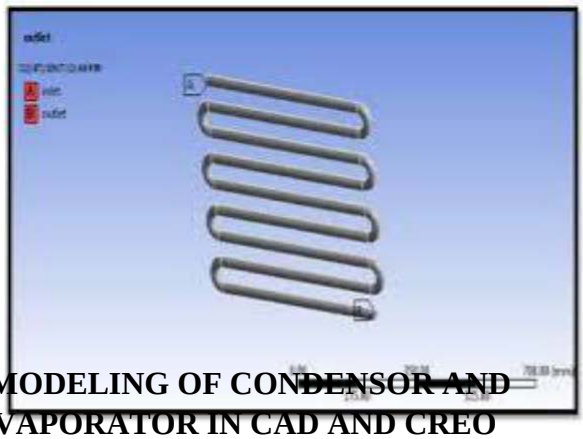
There are some gaps identified

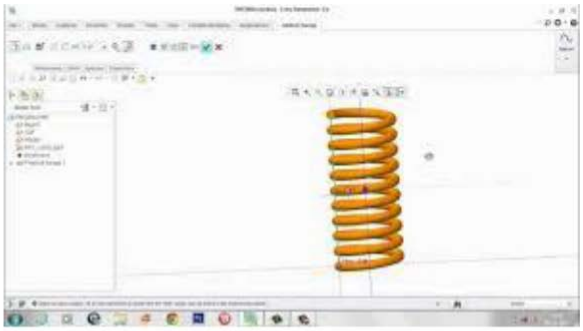
1.The exhausted waste heat from the running coach engine is well-established by simulation calculation. The calculative results have fine coincidence with the tested data.

2. On the basis of the quantitative analysis of the exhausted gas parameters, the main devices are determined in the absorption compression hybrid cycle driven respectively by the waste heat of exhaust gases and power from the coach engine. One dimensional steady distribution parameter model in the generator and lumped parameters model in the other heat exchangers are established, for coupling heat transfer in the unt.

3. The ARSC can completely meet the demand of coach space cooling, when the running speed (u) is greater than 100 km/h; the ARSC together with the CRSC supplies the cooling capacity for the coach, when u is between 40 and 100 km/h; When u is lower than 40 km/h, the ARSC has no cooling effect, and the cooling demand for the coach is fully supplied by the CRSC. The characteristics of the ARSC are analyzed under different ambient temperatures. The performance of the ARSC drops with the rise in ambient temperature.

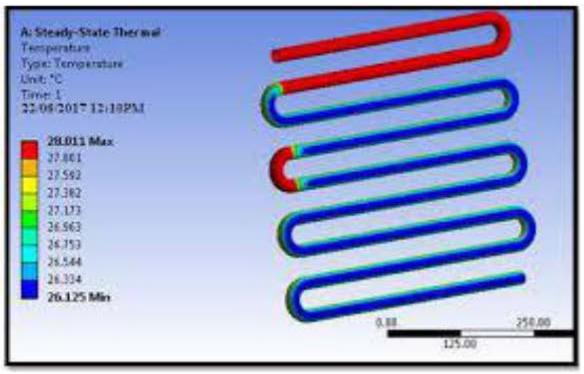
4. The ACHRC have advantages of meeting coach cooling demands by recovering the waste heat from engine and consuming less fuel oil. The compact and light weight structures are considered to apply into the key devices in the ACHRC

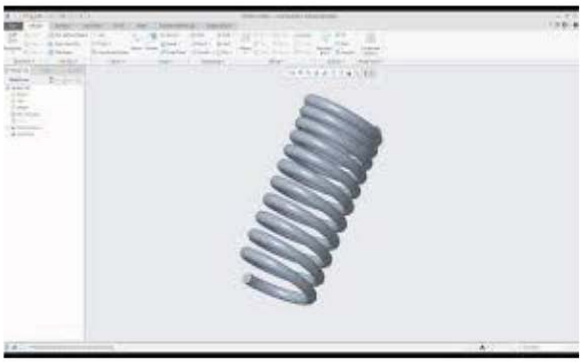


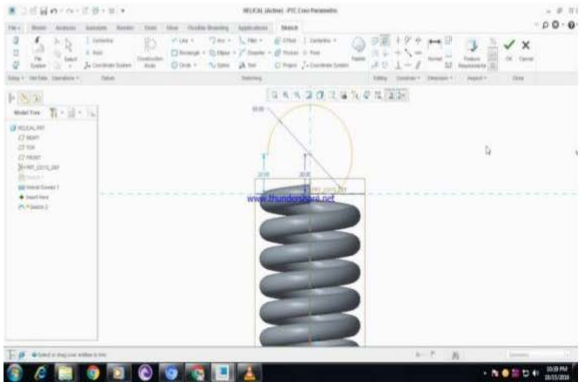


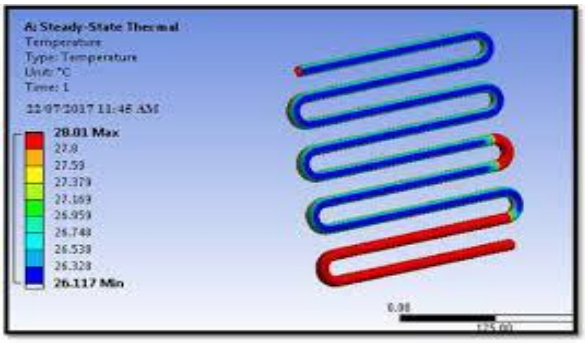
VI.MODELING OF CONDENSOR AND EVAPORATOR IN CAD AND CREO

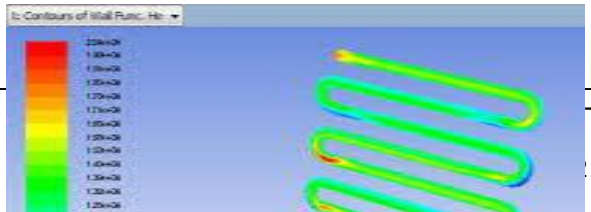
Condenser model











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Advantages

Uses Engine warmth as supply of energy for this reason enhances the efficiency of engine. Moving parts are handiest within the pump, that's a small detail in the machine therefore operation becomes smooth and also carrying and tearing is decreased. The system works at low evaporator pressures with out affecting the COP of the machine. Environmental friendly, no launch of CFC derivatives. Helps in shielding OZONE layer from depletion. Helps engine to cool, as it extracts warmth from engine. Low jogging value. Higher engine electricity performance.

VII.CONCLUSION

1. In the exhaust gases of motor vehicles, there is enough heat energy that can be utilised to power an air-conditioning system. Therefore, if air-conditioning is achieved without using the engine's mechanical output, there will be a net reduction in fuel consumption and emissions.

2. Once a secondary fluid such as water or glycol is used, the aqua-ammonia combination appears to be a good candidate as a working fluid for an absorption car air-conditioning system. This minimises any potential hazard to the passengers.

3. The low COP value is an indication that improvements to the cycle are necessary. A high purity refrigerant would give a higher refrigeration effect, while the incorporation of a solution heat exchanger would reduce the input heat to the generator. The present system has both a reflux condenser and a heat exchanger. However, the reflux condenser is proved inadequate to provide high purity of the refrigerant and needs to be re-addressed. The evaluation of the COP, with and without the heat exchanger also proves that unless there is a high purity refrigerant, the effect of the heat exchanger to the generator's heat is small.

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