HBRP
PUBLICATION

Research and Applications of Thermal Engineering
Volume 3 Issue 3

A Novel Development of Vapor Absorption Air-Conditioning System using Engine Exhaust Heat

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ABSTRACT

With the exponential rise in population, energy crisis has reached the pinnacle in the present scenario. Hence, motivation to shift towards utilization of waste heat recovery has become a necessity now a days. This work deals with the development of single effect ammonia absorption air -conditioning system of 1.5 TR using waste heat from IC engine exhaust. The automobile exhaust waste heat is taken as source for generator heat input and the performance of the system was calculated. The system was run on a daily basis for 2 hours and variation in the performance of the system was plotted. The exhaust system was developed by using an exhaust pipe of an automobile where the heat was supplied through gas cylinder .Initially the maximum temperatures generated in an actual engine were calculated and based on those calculations the model was heated up to that temperatures and the system was made to run on trial. When the system produced us with the desired effect the performance was calculated and the variation in performance was plotted. Hence, here an aim is made towards the development of sustainable energy model air-conditioning system where the dual advantage of reduced energy consumption and ozone depleting refrigerants are avoided. If properly implemented this research would provide a breakthrough in the field of waste heat utilization and development of energy-controlled usage of air conditioning systems.

***Keywords**:-Ammonia, Absorption System, Waste heat, 1.5 TR, Air- conditioner.*

INTRODUCTION

The two main sensational topics in the present-day world are the energy crisis and global warming. Researchers are having tough time finding a solution for these problems. Hence, this work deals with the development of a vapour absorption air conditioning system using exhaust heat of an IC engine as the source for input. Waste heat utilization is becoming a necessity day by day due to the demand in energy consumption posed by the global population and the near extinction of fossil fuels. Concentration on the same concept is done in this work where utilizing the waste heat generated in an automobile engine is used as the heat energy for generating the desired refrigerating effect. As it is a well known fact that Vapor absorption system uses the heat energy to separate the refrigerant and the absorbent which causes the cooling effect to be generated hence it is aimed to develop the system by utilising the heat generated in an exhaust system of a 4 stroke I.C.engine. As the entire heat released is directly emitted into the atmosphere so if we regulate this heat into a proper direction such as a vapor absorption system miraculous results can be expected in the near future. Hence generation of an Air conditioning system with the exhaust waste heat is the novel concept in this work.

LITERATURE SURVEY

Michael Papapetroua et al[1] found a way to utilize waste heat of engine exhaust from automobiles in generating refrigerating effect.

Kajal Sarmah, Pushpendra Gupta[2] in their paper studied about the analysis of Lithium bromide, water vapor absorption refrigeration system using the mole concentration concept.

PongsidSrikhirin et al[3] studied about the various vapor absorption refrigeration systems present and the working fluids which may be used to get various outputs.

Arturo González Gilstudied[4] about solar air cooling on single & double effect Lithium Bromide vapor absorption refrigeration system.

Benjamin Bronsema[5] identified the problems faced in hybrid ventilation systems and provided certain solutions to them.

T. O. Ahmadu[6] studied about a lithium bromide chiller, which gave a maximum C.O.P of 0.42 .The source utilized was waste heat in this experiment.

Mr. Aniket Gandhi & Dr. R. R.Arakerimath[7] studied about solar vapour absorption cooling system utilizing parabolic solar dish collector where the C.O.P was obtained to be 0.72 for the cycle.

JoydeepChakraborty et al[8] studied about lithium bromide vapor absorption system using solar energy.

Anan Pongtornkulpanich [9] studied about a new pair of absorbent and refrigerant in vapour absorption system using activated carbon and methanol providing the required heat through solar energy.

Sohail Bux A.c.Tiwari[10] studied about designing a lithium bromide vapor absorption refrigerator providing the design conditions necessary for the heat exchangers.

The literature survey states that most of the works related to vapor absorption system is done related to development of refrigerator very few works related to development of Vapor absorption air conditioning system is done hence this work is in this direction for development of an ammonia water vapor absorption air conditioning system.

EXPERIMENTAL SET-UP

The experimental set up consists of a vapor absorption air conditioning system. The input energy is taken from the exhaust of an automobile engine. The exhaust pipe is wound with copper coil which acts as the generator where the heat is absorbed and the separation of refrigerant absorbent takes place. After passing through the generator it enters the absorber and the refrigerant enters the condenser. From the condenser the refrigerant passes into an expansion valve where it gets expanded and the pressure reduction takes place.

Next, it enters the evaporator and allows the cool air to pass into the cooling space giving the required desired effect. From the evaporator the refrigerant passes into the absorber where it again mixes with the absorbent forming a solution. This solution is pumped into the generator which raises the pressure of the solution as it enters the generator. In this way a cyclic process is developed generating the necessary refrigerating effect.

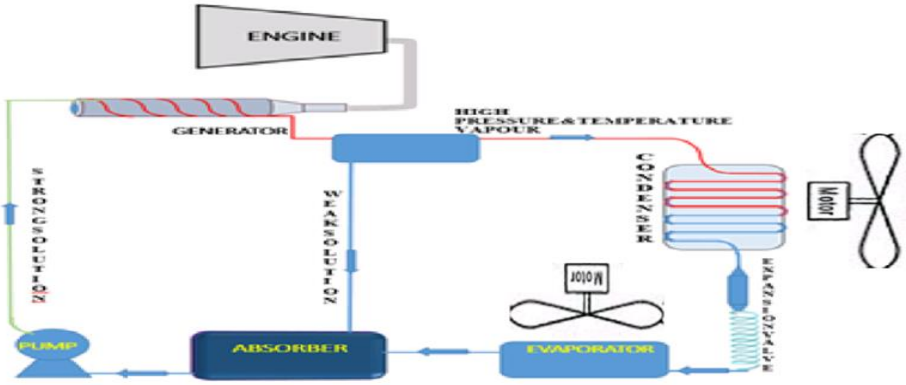

Fig.1:-*Cyclic representation of Vapor Absorption Air-conditioning system*

RESULTS & DISCUSSIONS

Table 1:-*Values representing the C.O.P for 30 days along with the corresponding evaporator, Condenser & Generator temperatures.*

Sl. no	Evaporator temperature in K (T_E)	Condenser temperature in K (T_C)	Generator temperature in K (T_G)	C.O. P	DAY
1.	298	318	353	1.477	1
2.	294	314	353	1.58	2
3.	290	318	376	1.597	3
4.	298	317	354	1.6788	4
5.	296	315	356	1.794	5
6.	289	310	358	1.845	6
7.	295	313	353	1.856	7
8.	297	315	351	1.692	8
9.	290	310	356	1.87	9
10.	295	316	358	1.64	10
11.	296	316	357	1.699	11
12.	295	314	357	1.871	12
13.	294	314	355	1.697	13
14.	300	314	360	1.94	14
15.	297	315	358	1.98	15
16.	285	308	358	1.73	16
17.	288	310	358	1.75	17
18.	290	309	356	1.989	18
19.	292	312	356	2	19
20.	289	301	355	1.873	20
21.	296	312	350	2	21
22	289	314	355	1.355	22
23.	289	308	355	1.873	23
24.	292	318	359	1.243	24
25.	285	309	360	1.68	25
26.	295	316	360	1.716	26
27.	293	315	358	1.599	27
28.	291	318	365	1.368	28
29.	294	320	360	1.3611	29
30.	*289*	*309*	*355*	*1.873*	*30*

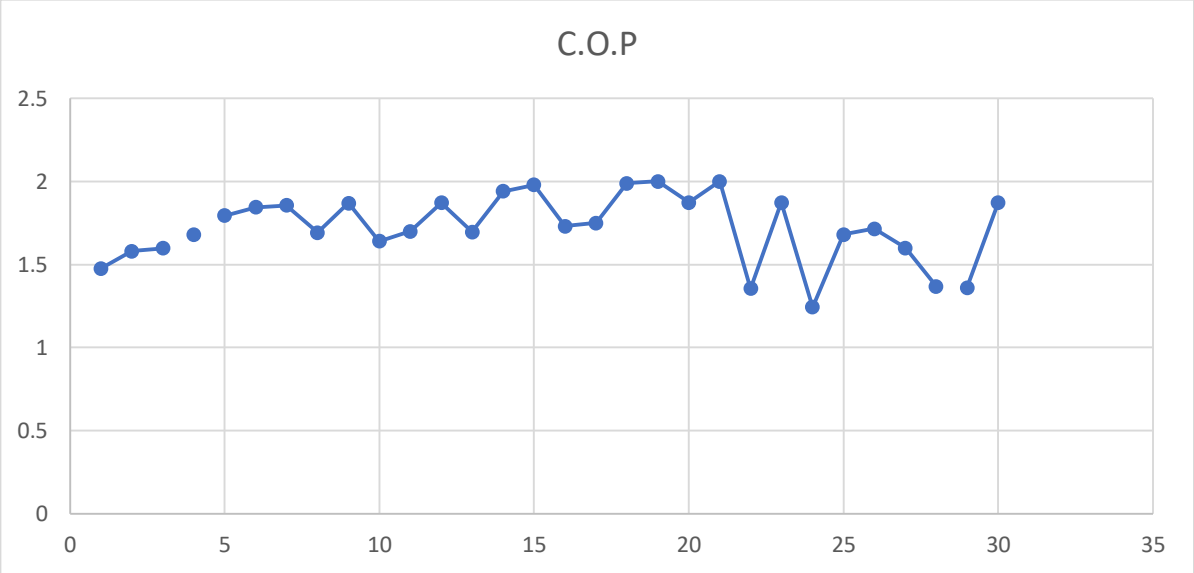

Fig.2:-*Representing the plot between the C.O.P VS DAY for 30 days respectively.*

CONCLUSION

40% of power consumption among electrical equipment is due to the air conditioners used in our household. Hence this work aims at solving this problem by using the waste heat technology to generate a vapor absorption system to develop the required refrigerating effect for a 1.5 TR air conditioner. Although some amount of power is used in operating the pump, the fans utilised in the condensers and evaporator the power consumed by this is many times lesser than the power consumed in a vapor compression system. Although a compromise has been made with the Maximum COP developed in this system for its counterpart of a vapor compression system which boasts of around 3.5. It is generated at a cost of 60% greater than this vapor absorption system. Hence this work poses of providing a solution to the most important and burning problem of reduction in global warming by using reduced power in its system, eradication of ozone depletion layer as the refrigerant used is ozone friendly. Although it is a small step towards providing a solution to giant problems of global warming and utilising unharmful refrigerants further designing and development of an improved COP will definitely create a lot of buss on such works in near future which is the proposed future work.

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