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A Review Paper on Design of Generator in Vapour Absorption Refrigeration System

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ABSTRACT
In vapour absorbtion refrigeration system an absorber, a pump, a generator and a pressure reducing valve replace the compressor. We can also operate the generator with low thermal energy by exhaust heat of IC engine. The fossil fuel remain main source of energy but contribute a tremendous amount of pollutants in the environment leading to global warming ,so for the purpose of refrigerator and air conditioning a vapour absorption refrigeration system could be used. this system utilizes the wasteful heat from heavy vehicle exhaust and work on VARS which provides the cooling and reducing various costs like fuel and maintenance. The research has been done in order to recover maximum waste heat and then analyzing the system performance. Through this system the researchers has tried to find out the maximum COP. It has been found by research that generator temperature has the most effect on the release of the system.

KEYWORDS: Generator, Waste heat, COP and VARS

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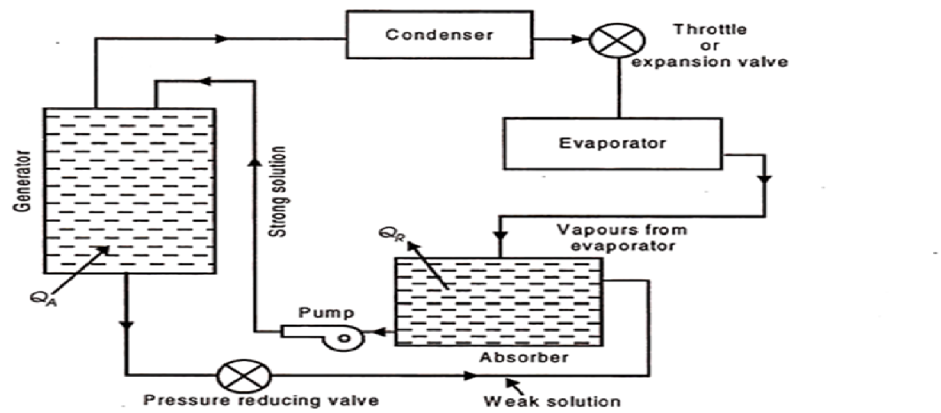
INTRODUCTION

Vapour Absorption Refrigeration System is an attractive method for utilizing low grade energy directly for cooling. This is an important advantage as against the conventional vapour compression system which operates on high grade energy. There are four basic components an evaporator, condenser ,generator and absorber in VARS. . First the refrigerant flows from the condenser into the evaporator, then absorber to the generator and back to the condenser, infect the absorbent passes from absorber to the generator and back to absorber. the pressure difference between the high pressure portion and low pressure portion is maintained as small as possible for maximum efficiency. the starting cost of this systems is at present higher but their operating expenses are always low. Since, the efficiency of vapour absorption refrigeration system is determined largely by the properties of thermodynamics of the refrigerant an absorbent combination, an intensive study of these properties is importance in the development of an efficient refrigeration system. For increasing the COP of vapour absorption refrigeration system we used analyser and rectifier. Analyser is used to remove the partial vapour from refrigerant and for complete removal of vapour to the refrigerant we used a rectifier.



Equipment replacing the compressor (Simple vapour absorption system of refrigeration)

Q_A = Heat added or supplied
Q_R = Heat rejected to coolant.

Refrigeration-lowering the temperature of an enclosed space by removing heat from that space and transferring it elsewhere

Evaporator: The refrigerant at very low temperature and pressure enter the evaporator and produces the cooling effect. The refrigerant flows to the absorber that acts as the suction part of the refrigeration cycle.

Absorption: A second fluid, in depleted state, sucks out the now gaseous refrigerant, thus providing the low partial pressure. This produces a refrigerant-saturated liquid which then flows to the next step.

Generator-The refrigerant solution in the generator is heated by the external source of heat. its works is the solution of ammonia and water ,which converts it into vapour. It also has an analyser, it is the work of analyser that separates the particle of water from ammonia vapour by condensing the particle of water, it falls down and further increases the ammonia vapour.

Maximum COP of ideal absorption refrigeration system

The maximum possible COP of a refrigeration system operating between three temperature levels can be obtained by applying first and second laws of thermodynamics to the system.
The COP is ratio of (Qe) and (Qg+Wp)
But; Wp<<Qg
So; COP ia equal to ratio of Qe and Qg
the ideal cop is only a function of operating temperatures (Te,To and Tg)
VAS has lower cop compared to VCRS because VARS works on low grade energy (heat energy)

Literature review of vapour absorption refrigeration system-

Anand and Kumar [1] find out the availability, calculated irreversibility in different component of single/double LiBr/Aqueous system with the use of Gibbs Duhem equation. using different H-t-X, P-T-X data and curve for comparing and find out the different parameter calculation as like entropy in absorption machine.

Tyagi [2] using the different type of chart and table as like P-T-X, H-T-X and Refrigerant-P-H. tyagi comparing different type of chart and table for designing of V.A.R.S and also find out the mass flow rate equation. Which used in designing of VARS .SO that he designed different parameters of aqua -ammonia vapour absorption refrigeration system. and find out COP and work done are the function of evaporator, absorber, and condenser and generator temperature. Which depends on the properties of binary solution.

Ercan and Gogus [3] using the exergy and gibbs free energy equation with ARS data analysis. and find out the irreversibility's in components of aqua-ammonia absorption refrigeration system by 2nd law analysis. They calculated the dimensionless exergy loss of each component in VARS. and also calculated cop and circulation ratio for different component of VARS. find out the aqua-ammonia system needs a rectifier for high ammonia concentrations which lead to additional exergy loss in the system. dimensionless total exergy loss depends on generator temperature.

Oh et al [4] find out the performance of absorption heat pump in the cooling mode of operation. which investigated through the cycle simulation and so that we easily obtain the system characteristics in LiBr/aqua absorption heat pump of paralle flow type. for cycle analysis of absorption system, they used the method of air cooled doublr effect absorption heat pump (parallel flow).

Aphornratana and Eames [5] find out the performance of LiBr/Aqua absorption refrigeration system as like irreversibility and exergy analysis. Which used the method of second law of thermodynamic as applied to a single Effect absorption refrigeration system.

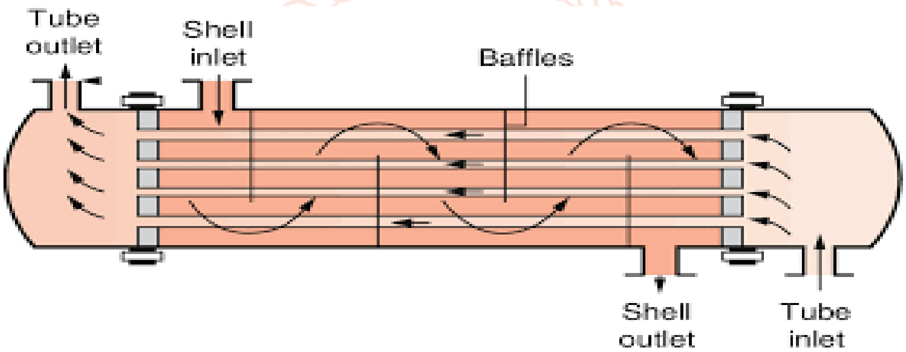
Bell et al [6] designed a LiBr/aqua experimental absorption cooling system. which driven by heat generated of solar energy. for observing they housed it in evacuated glass cylinders to observe. They calculated the thermodynamic performance of the cooling system by applying first law of thermodynamics. They assumed that the working fluids are in equilibrium and the temperature of the working fluid leaving the generator and absorber is equal to the temperature of generator and absorber respectively. They find out that the COP of the system depends on generator temperature. by using the law they optimize the design of absorption system by improving performance of different component of absorption system.

I Horuz [7] compared the aqua/ammonia and aqua/LiBr solutions in vapour absorption refrigeration system. Which easily find out the better comparison performance on the basis of C.O.P., Cooling capacity and the maximum/minimum pressure in between different two solution of vars .So that aqua/LiBR is better than ammonia/aqua solution in VARS. However, problem of crystallization lies with AQUA-lithium bromide system.

Kumar et al [8] focused on detailing the exergy variation in solar assisted absorption system. Kumar conclued that rise in heat transfer of first stage generator and decreases the heat transfer in second stage generator. So that increased in second generator temperature decreases the exergy and energy transfer rates at the condenser of absorption system . so that they find out the availability at the devices varies with respect to quality of the double effect absorption refrigeration system.

Talbi and Agnew [9] analyzed on the exergy energy of single effect LiBr/aqua absorption refrigeration systems. So that author developed a computer simulation model based on first/second law of thermodynamic analysis and also on the basis of thermodynamic properties. This cycle collects waste free heat from the exhaust of diesel engine. and used the law of thermodynamics and find out the dimensionless total exergy loss and exergy loss of every part of single effect absorption refrigeration system. They conclude that the absorber has the highest exergy loss of 59.06% followed by generator. So that demonstrating the advantages of exergy process are effective in the single effect LiBr/aqua absorption refrigeration system, which are other wise not accounted in the heat balance method.

Design of generator- Heat exchanger are used in manufacturing and industrial process for many applications. We used shell and tube type heat exchanger for the given application is depends many factors like low costs, available recourse ,Connection in the field and many more. a shell and tube heat exchanger is designed for heating hot oil and steam. The heat exchanger shall be designed that the hot oil flows through the tubes and steam through the shell side of the heat exchanger. It is assumed that a large steam flow rate is available to provide the required heating for the hot oil in the shell and tube heat exchanger. For design shell and tube type heat exchanger, a conventional NTU approach and LMTD approach shall be used. First of all in design analysis we choose an appropriate NTU corresponding to required HX effectiveness and capacity rate ratio. The overall heat transfer coefficient the required surface area of the heat exchanger was determined by using NTU The required tube diameter, tube length and tube passes were then extrapolated from the heat exchanger surface area. It is a common practice to install tube sizes of 1/2inch, 5/8 inch, 7/8 inch, and 1 inch in shell and tube heat exchangers. Tubes usually come in 6 ft, 8 ft, 12 ft and16 ft tube lengths. For the current analysis, a carbon steel tube having a wall thickness is 16 BWG and a length of 6 ft. hot oil velocity in tubes was assumed as 3 m/s. In industries, for practice maintain the tube velocity under 6 m/s. the overall design and description of the shell and tube heat exchanger that no. Of tubes is 7,length is 6, required NTU is 0.13,heat transfer surface area is 0.47m2,flow velocity flow tubes is 3m/s, Tube pitch is 0.9375inch and baffles material is carbon steel. We study another paper and the researchers found that generator has the capacity of 5kw and it has 50cm long,25cm wide ,15cm high wiyh no of tubes approx 37. inner diameter is 1.6and outer diameter is 2.13cm the value of COP has approx 1.0 by the method used the log mean temperature difference method and other paper the researchers found for designing the generator The cooling capacity of refrigerator is 0.80 TR, exhaust heat 2.62KW, Heat given in generator 4.80kj/sec Heat from Heat Exchanger 8.33 kj/sec ,C.O.P 0.57 and load estimation etc. By Used the different formula for execution of proposed plan throughout the Quantification of exhaust temperature ,examination of exhaust heat, evolution of VARS and calculation of heat required for analysis in system.



Waste heat recovering from engine-Waste heat is generated by the process of fuel combustion and chemical reaction, after reaction it dumped into the environment. Even though it could reduced for economical reason. There are four sources of waste heat from a reciprocating engine: exhaust gas, engine jacket cooling water, tube oil cooling water and turbocharger cooling spread to the atmosphere during engine run time. We known that an IC engine has an efficiency of about 35-40%, which means that only one-third part of the energy in the fuel is converted into useful work and about 60-65% is wasted to environment.

A low-grade temperature heat from the exhaust gas is not efficient converted to electrical power by using conventional methods as seen in industrial waste heat recovery systems., these low-grade temperature heat sources using Rankine cycle is discussed. In system by utilizing the organic rankine cycle many researchers found that decrease in fuel consumption up to or more than 10% for their car and reported for truckstjat improves 10%of fuel consumption for their trucks.

Waste heat recovering system is the system of the recover heat from the streams and transforms it into a useful form for utilization. It is done by using energy conversion devices. The heat energy contained in exhaust gases are recovered in some methods like initially the waste heat energy is utilized to burn an additional amount of fuel and after burning fuel a thermoelectric generator produced electrical energy by the help of utilizing the heat of exhaust gas and last term is energy recovering is completed by the help of coupling a compressor and an alternator.

Summary of literature review on vars and design of generator

S. No.	AUTHOR	DESCRIPTION	METHODOLOGY	FINDINGS
1	D.K.Anand and B.kumar	Absorption Machine Irreversibility using new entropy calculations	Used the P-T-X data, curve with Gibbs Duhem equation	Analysis of availability and calculate irreversibility in system components of single/double effect LiBr/aqueous system.
2	K.P.Tyagi	Design parameters of an aqua-ammonia vapour absorption refrigeration system	Different type of chart and tables as like P/H-T-X and Refrigerant-P-H are used in that method	Design of V.A.R.S with the help of C.O.P. and mass flow rate.

3	O. Ercan Ataer and Yalcin Gogus	Comparative study of irreversibilities in an aqua-ammonia absorption refrigeration system	Used the exergy and gibbs free energy equation with A.R.S data analysis and also different curve with exergy loss, A.R.S. and different component temperature.	The dimensionless exergy loss of each component, the exergetic coefficient of performance, C.O.P and circulation ratio of different vars component.
4	M.D. Oh, S. C.Kim, Y. L. Kim and Y. I. Kim	Cycle analysis of an air-cooled LiBr/Aqua absorption heat pump of parallel-flow type	Used the method of Air cooled double effect absorption heat pump (parallel flow type)	performance of absorption heat pump in the cooling mode of operation was investigated through cycle simulation to obtain the system characteristics
5	S. Aphornratana and I. W. Eames	Thermodynamic analysis of absorption refrigeration cycles using the second law of thermodynamics method	2nd law of thermodynamics method as applied to a single-effect absorption refrigerator cycle	Performance of LiBr/aqua absorption refrigeration system as like exergy analysis and irreversibility
6	LA. Bell, A.J. Al-Daini, Habib AI-AK, RG. Abdel-Gayed and I Duckers	The Design of an Evaporator/Absorber and Thermodynamic Analysis of a Vapor Absorption Chiller Driven by Solar Energy	Used of experimental apparatus of evaporator/absorber cell which driven by solar heat energy collector system	To optimize the design of LiBr/aqua absorption system by improving performance of different component of absorption system
7	I. Horuz	A Comparison between ammonia-water and water-LiBr solutions in V.A.R.S	Used the curve between different parameters of different component of V.A.R.S. to find out a comparison	Comparison performance on the basis of C.O.P. ,cooling capacity and the maximum/minimum pressure in between aqua-LiBr and ammonia-water. In which aqua-LiBr is better than ammonia- water
8	Ravikumar T.S., Suganthi L. and Anand A.Samuel	Exergy analysis of solar assisted double effect absorption refrigeration system	Used Exergy analysis of solar assisted double effect absorption refrigeration system	exergy variation in the solar assisted absorption system.
9	M.M. Talbi and B. Agnew	Exergy analysis: an absorption refrigerator using lithium bromide and water as the working fluids	Used the exergy (2nd law analysis) method	exergy analysis is carried out on single-effect absorption refrigeration cycle with LiBr and water
10	Arun Bangotra	Design - Analysis of Generator of Vapour Absorption Refrigeration System for Automotive Air-Conditioning	Used The Logarithmic mean temperature difference method	Design of cross flow type generator having capacity of 5 KW
11	Sandeep Chakraborty and Dr. Pravin Kumar Borkar	A Review Paper on Extracting Waste Heat from the Engine Exhaust and Reutilizing in Car Air Conditioning	Used the different formula for execution of proposed plan through out the Quantification of exhaust temperature, examination of exhaust heat, evolution of VARS and calculation of heat required for analysis in system	For designing the generator :The cooling capacity of refrigerator is 0.80 TR, exhaust heat 2.62KW, Heat given in generator 4.80kj/sec Heat from Heat Exchanger 8.33 kj/sec ,C.O.P 0.57 and load estimation etc.
12	Amir Asgari Tahery, Shahram Khalilarya and Samad Jafarmadar	Effectively designed shell-tube heat exchangers considering cost minimization and energy management	Using the NTW design technique	optimization of shell-and-tube heat exchangers by reducing annual exergy destruction cost and annual total cost .
13	Amin Hadidi, Mojtaba Hadidi and Ali Nazari	A new design approach for shell-and-tube heat exchangers using imperialist competitive algorithm (ICA) from economic point of view	Using the Imperialist competitive algorithm (ICA) technique	optimal design of shell and tube heat exchangers with higher accuracy in less computational time.

14	Arzu Sencan Sahin, Bayram Kılıç and Ulas Kılıç	Design and economic optimization of shell and tube heat exchangers using Artificial Bee Colony (ABC) algorithm	Using the technique of Artificial Bee colony Algorithm	Design and economic optimization of shell and tube heat exchangers
15	Khaled S.Alqdah,Sameh Alsaqoor and Aseem Al-Jarrah	Design and Fabrication of Auto Air Conditioner Generator Utilizing Exhaust Waste Energy from a Diesel Engine	For Design and Analysis of The Proposed Mode using Log mean temperature difference method	Generator has the capacity of 5 KW. It has 50cm long,25cm wide and 15 cm high with number of tubes approx 37 and inner/outer diameter are 1.6/2.13 cm. the value of C.O.P has approx 1.0.
16	A. Ponshanmuga Kumar and R. Rajavela	Experimental Analysis of Vapour Absorption Generator integrated with Thermal Energy Storage system	Used the Log mean temperature difference method	Design the only Generator heater and fabricated with the use of thermal energy
17	Kartik Silaipillayarputhur and Hassan Khurshid	The Design of shell and tube Heat Exchangers	Use the method of L.M.T.D, E-N.T.U, and Capacity rate ratio for a given application	Design of shell and tube type heat exchanger with the help of different type of charts and table
18	Ahmed Ouadha and Youcef El-Gotni	Integration of an ammonia-water absorption refrigeration system with a marine Diesel engine: A thermodynamic study	Used the method of first law thermodynamic analysis in modal of V.A.R.S. and also condition of steady state	Find the feasibility of using waste heat from marine Diesel engines to drive an ammonia-water absorption refrigeration system
19	S.L. Nadaf and P.B.Gangavati	A review on waste heat recovery and utilization from diesel engines	Organic Rankine cycle, Thermoelectric Modules and A.C. and Refrigeration	Increasing the combustion process efficiency, Reduction on pollution, equipment sizes

Conclusion

for the basis of literature review it has been noticed that VARS system has an interesting scope in making the low grade waste heat into effective energy. The system performance depends upon the temperature given to generator and components being used and how better they respond. Though temperature variation in generator is one of the main parameters of performance but it depends how much could be extracted from exhaust. One other advantage of this system is that it has no effect on the environment. In this paper reviews design of a shell and tube type heat exchanger with the help of used e-NTU and LMTD method. It is very popular and analytical method. The most part of proper section of NTU and capacity rate ratio. The determination of NTU needs extensive calculation, which can take longer..these two parameter estimated, the researchers knows the limitations and can easily extrapolate the complete information of design of heat exchanger. The recovery of waste heat also reduces the amount of waste heat. It is shows the availability of waste heat from internal combustion engine.

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