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Recovery of Engine Waste Heat for Reutilization in Air Conditioning System in Automobile.

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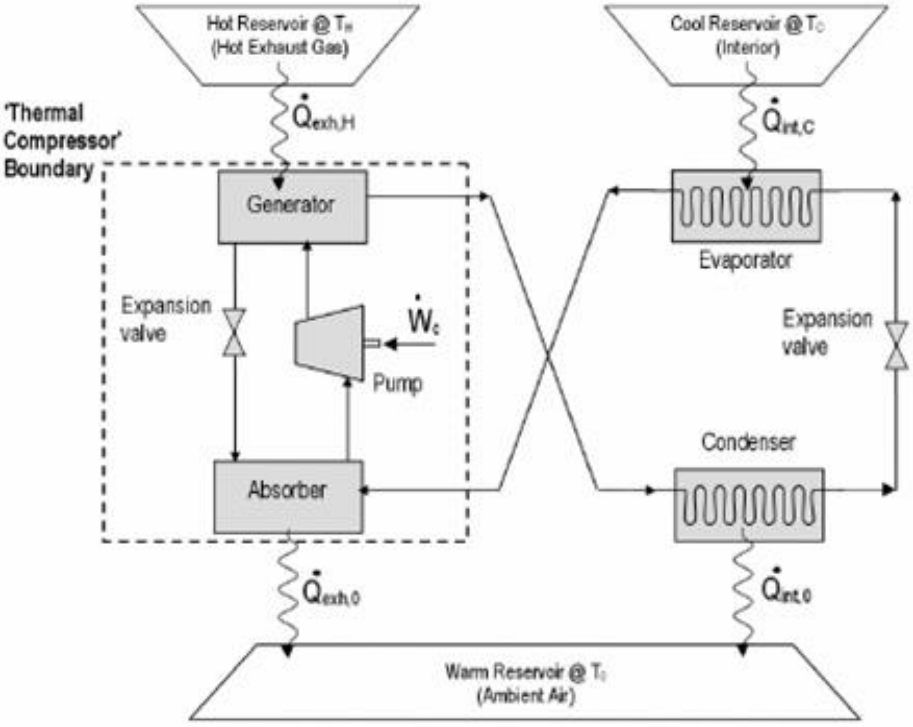
Abstract-- With the rapid changing environment and atmospheric effect, the air conditioning of the moving vehicle has become a necessity. In the same time consumers are incapable to bear the increasing operating cost of the vehicles due to continuous raise in fuel prices, component costs and maintenance costs associated with vehicles. More recently, several new philosophies for manufacturing improvement have been developed and implemented in various sectors, be it manufacturing, service or other. Keep in mind in this paper, an exploration has been done to research the possibility of waste heat recovery and its subsequent utilization in air conditioning system of a vehicle without increasing the component cost, weight, number of component and bring improvement in vehicle by making luxurious.

I. INTRODUCTION

Industries are vaying for various tools and techniques for competitive advantage over the competitors in an ever-changing global market by combining factors like quality, cost, flexibility, responsiveness, and innovation. I n today's global market, there is constantly increasing pressure to make products more quickly, with more variety, at the lowest possible cost. In the end, those companies that meet and exceed customers' demands will succeed by remaining competitive. T hen, "the question is, how do companies become competitive and retain their competitiveness?" This question may not be easy to answer because manufacturing systems are complex, and simple solutions to manufacturing problems may not exist.



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Therefore, companies must choose from available techniques to develop their own solutions in the existing products to attract the customers in their fold without adding extra cost.

With the rapid changing environment and atmospheric effect, the air conditioning of the moving vehicle has become a necessity. Air conditioning of a vehicle can be done by Vapour Compression Refrigeration System (hereinafter VCRS) and Vapour Absorption Refrigeration System (hereinafter VARS). Presently, in the vehicles VCR S is in use in most of the cases. In lieu of VCRS, if, VARS is used in vehicles the refrigeration system could be operable in a vehicle without adding running cost for air conditioning.

There is a great impact on the running cost of vehicle due to increasing cost of fuel. The A/C system adds nearly 35 % extra cost in fuel expenses. Alternately, it is a matter of investigation that waste recovery of an engine for application in A/C can reduce the fuel economy of vehicles to what maximum extent? It has been revealed that there is great potential to reduce A/C fuel consumption because A/C systems have traditionally been designed to maximize capacity, not efficiency. From the reviews of various literatures there is an indication that reducing the A/C load decreases A/C fuel consumption.

Absorption Cooling System

Absorption is the process of attracting and holding moisture by substances called desiccants.

Desiccants are sorbents, i.e. materials that have an ability to attract and hold other gases or liquids, which have a particular affinity for water. During absorption the desiccant undergoes a chemical change a s it takes on moisture, as for example the table salt, which changes from a solid to a liquid as it absorbs moisture. The characteristic of the binding of desiccants to moisture makes the desiccants very useful in chemical separation processes. Ammonia water combination possesses most of the desirable qualities which are listed below:

- Latent heat of ammonia at 1515^{O}C = 1314 kJ/kg.
- Critical temperature of NH3 = 132.6 132.6^{O}C.
- Boiling point at atmospheric pressure = 33.333.3^{O}C

The NH 3 H 2 O system requires generator temperatures in the range of 125°C to 170°C with air cooled absorber and condenser and 80°C to 120°C when water cooling is used. These temperatures cannot be obtained with flat plate collectors. The coefficient of performance (COP), which is defined as the ratio of the cooling effect to the heat input, is between 0.6 to 0.7. Ammonia is highly soluble in water and this ensures low solution circulation rates. Both constituents are obtainable at minimal cost. The choice of Ammonia water combination is not made without considering certain disadvantages: ammonia attacks copper and its alloys when it has been hydrated. Therefore, all components are made from mild steel or stainless steel.

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Comparison between Vapour Compression and Absorption system

S|No.	AbsorptionSystem	CompressionSystem
1	Uses low grade energy like heat. Therefore,may be worked on exhaust systems from I.C engines,etc.	Using high-grade energy like Mechanicalwork.
2	Moving parts are only in the pump, which isa small element of the system. Hence operation issmooth.	Moving parts are in the compressor. Therefore, more wear, tear and noise.
3	The system can work on lower evaporator pressures also without affecting the COP.	The COP decreases considerablywith decrease in evaporatorpressure.
4	No effect of reducing the load onperformance	Performance is adversely affected atpartial loads.
5	Liquid traces of refrigerant present in pipingatthe exit ofevaporator	Liquid traces in suction line may damagethe compressor
6	Automatic operation for controlling the capacity iseasy.	It isdifficult.

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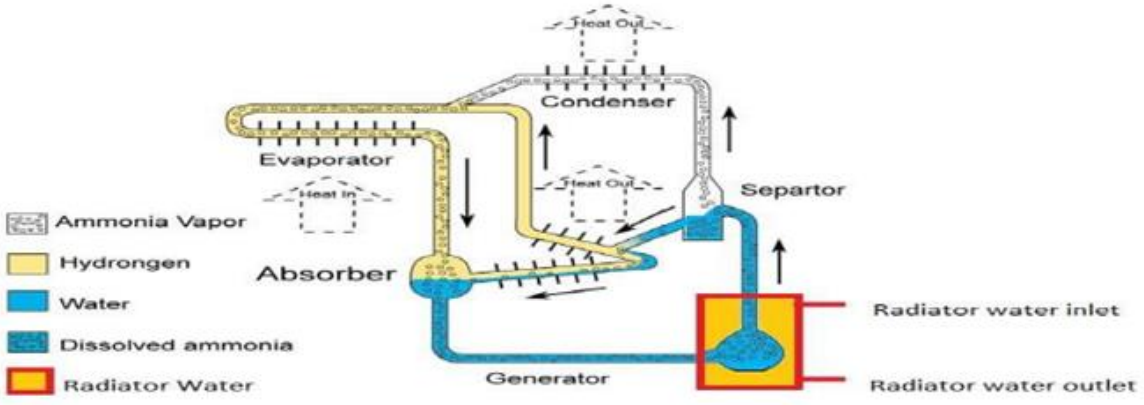
II. METHODOLOGY



The proposed model is based on three fluid vapour absorption systems. It will contain basic components needed for vapour absorption system as shown in Fig.

- The three-fluid used in this system will be ammonia, water and hydrogen. The use of water is to absorb ammonia readily. The use of hydrogen gas is to increase the rate of evaporation of the liquid ammonia passing through the system.
- Even though ammonia is toxic, but due to absence of moving part, there will be little chance for the leakage.
- The hot radiator water will be used to heat the ammonia solution in the generator. To remove water from ammonia vapor, a rectifier will be used before condenser. The ammonia vapor is condensed and flows under gravity to the evaporator, where, it meets the hydrogen gas. The hydrogen of gas, which is being feed to the evaporator, permits the liquid ammonia to evaporate at low pressure and temperature.
- During the process of evaporation, the ammonia will absorb the latent heat from refrigerated space and produces cooling effect. The mixture of ammonia vapor and hydrogen will be passed to the absorber where ammonia will be absorbed while hydrogen raises the top and flows back to the evaporator.

III. COMPONENTS

1. Condenser:

In systems involving heat transfer, a condenser is a device or unit used to condense a gaseous substance into a liquid state through cooling. In so doing, the latent heat is released by the substance and transferred to the surrounding environment.

2. Evaporator:

An e vaporator is a device in a process used to turn the liquid form of a chemical substance such as water into its gaseous form/vapor. The liquid is evaporated, or vaporized, into a gas form of the targeted substance in that process.

3. Separator:

A gas liquid separator for use in a refrigeration circuit having a rotary compressor in which oil is mixed with refrigerant as the latter is circulated through the refrigeration cycle, said separator being situated between

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the compressor and the condenser portio n of the cycle and including a swirl chamber for receiving.

4. Absorber:

The absorber is a sort of vessel consisting of water that acts as the absorbent, and the previous absorbed refrigerant. Thus the absorber consists of the weak solution of the refrigerant (ammonia in this case) and absorbent (water in this case).

5. Generator:

In the generator a mixture of ammonia and water is heated. The boiling point of ammonia is lower than that of water, so it vaporizes, separating the refrigerant from the absorbent. Since the vapour is not a pure ammonia gas, it must be purified as it flows through rectification system.

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