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VAPOUR ABSORPTION REFRIGERATION SYSTEM USING ENGINE EXHAUST ENERGY

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Abstract **–Today automobiles uses the technology of vapour compression system to run the air-conditioning system that is required to cool the passenger and keep them in an optimal temperature range. But however the rising fuel cost and the load supported on the combustion engines limit prove to be disadvantages. Our proposed model is to take energy from engine exhaust and it is used as a source of vapour absorption system.**

Keywords – Automobiles, Technology, Vapour compression air-conditioning , Combustion engine, Energy from engine, Exhaust, Absorption system .

I. INTRODUCTION

Energy is an important entity for the economic development of any country. The rapid industrial and economic growth in India and China where one third population of the world is present has increased the need for energy rapidly in the recent years. Considering the environmental protection and also in the context of great uncertainty over future energy supplies, attention is concentrated on the utilization of sustainable energy sources and the energy conservation methodologies. High capacity engines are one of the most widely used power generation units. Nearly two-third of input energy is wasted through exhaust gas and cooling water of these engines. It is imperative that a serious and concrete effort should be launched for conserving this energy through waste heat recovery techniques. Such a waste heat recovery would ultimately reduce the overall energy requirement and also the impact on global warming

Waste heat is generated in a process by the way of fuel combustion or chemical reaction, and then dumped into the environment even though it could still be reused for some useful and economic purpose. Large quantity of hot flue gases is generated from boilers, furnaces and IC engines etc. If some of this waste heat could be recovered, a considerable amount of primary fuel could be saved. The energy lost in waste gases

cannot be fully recovered. However, much of the heat could be recovered and losses be minimized by adopting certain measures like EGR and vapour absorption system. Depending on the temperature level of exhaust stream and the proposed application, different heat exchange devices, heat pipes and combustion equipments can be employed to facilitate the use of the recovered heat. The shell and tube heat exchanger isthe most widely used type of industrial heat transfer equipment. Initially, only plain tubes were used in shell and tube heat exchangers. The heat transfer coefficient (h) for gases is generally several times lower than that for water, oil and other liquids. In order to minimize the size and weight of a gas to liquid heat exchanger, the thermal conductance (h_A) on both sides of the exchanger should be approximately the same.

Hence the heat transfer surface on the gas side needs to have a much larger area and be more compact than can be realized practically with the circular tubes commonly used in shell and tube exchangers.

VAPOUR ABSORPTION REFRIGERATION

3.1 REFRIGERATION CONCEPT

. Refrigeration is defined as, “the process of providing and maintaining a temperature well below that of surrounding atmosphere. In other words,”refrigeration is the process of cooling the

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substance". Refrigerator is the machine which is used to extract heat from a body at low temperature and then reject this heat to a high temperature body.According to second law of thermodynamics

3.1.1 REFRIGERATING EFFECT

It is defined as, "the quantity of heat extracted from a cold body or space to be cooled in a given time".

$$N = \frac{\text{Heat abstracted from cold space}}{\text{Time taken}}$$

3.1.2 CAPACITY OF REFRIGERATION

Capacity of refrigerating medium are expressed by cooling capacity. The standard unit for expressing cooling capacity is "ton of refrigeration".

One ton of refrigeration is defined as, "The quantity of heat abstracted to freeze one ton of water in a duration of 24 hours are 0°C".

Therefore ton of refrigeration = 3.5KJ/s

VAPOUR ABSORPTION REFRIGERATION SYSTEMS

In this system, compression process of vapour compression cycle is eliminated. Instead, following three processes are carried out .

1. Absorbing ammonia vapour in to water.
2. Pumping this solution to a high pressure cycle and
3. Producing ammonia vapours from ammonia solution by heating.

3.4.2 WORKING

In a typical vapour absorption system, ammonia is used as the refrigerant because it possesses most of the desirable properties. It is toxic, but since the system has no valves or moving parts, there is very little chance of leak and also the total amount refrigerant change itself is small. Liquid ammonia of refrigerant charge itself is small. Liquid ammonia evaporates in the presence of air /other gases, the lighter than gas faster than evaporation. Since hydrogen is the lightest gas and is non corrosive and insoluble in water it is used in the low side of the system. Water is used as the solvent because of its ability to absorb ammonia readily.

If liquid ammonia is introduced at the top of the system as shown in fig, it flows into the evaporator and evaporates. Hydrogen passes upward in the evaporator counter flow to the liquid ammonia that falls from one level to another. The ammonia vapour and hydrogen leave the top of the evaporator and pass through the gas heat exchanger here they warmed by the hydrogen flowing in the evaporator. Then they flow through the vessel on the left and into absorber. Weak aqua is introduce at the top of the absorber , ammonia as it passes counter flow through this unit. The hydrogen leaves the top of the absorber and flow through the heat exchanger on its way to the evaporator. The strong ammonia solution leaves the bottom of the absorber and flows into the generator at the lower right.

Heat is supplied at the generator, which drive the ammonia vapour out of the solution. This vapour would easily rise into the condenser, but some means of elevating the weak aqua so that it flows into the top of the absorber must be used. The principle of the bubble pump is applied here.

The discharge tube from the generator is extended down below the liquid end in the generator. As the vapour ammonia bubbles from and rise , they carry slugs of weak ammonia solution with them up the discharge tube into the separating vessel. From here weak ammonia solution flows to the absorber to repeat the cycle and vapour flow to the air cooled condenser to be liquefied and then flows into the evaporator.

Note the U bends in the weak solution line to the absorber and in the liquid line to the evaporator. These prevent the hydrogen from getting into the high side of the system.

The absolute pressure in the condenser is about the same as in the evaporator. Since practically pure ammonia is in the condenser its vapour pressure there is substantially equal to the total pressure. In the evaporator the ammonia vapour pressure is much less and in accordance, with Dalton's law of partial pressures, is equal to the total pressure minus the partial pressure of hydrogen. Being at a pressure below saturation pressure, the ammonia readily vapourizes in the evaporator and refrigerates.

Actually several refinements have been added to increase the efficiency and improve the performance. A liquid heat exchanger is used for the weak solution going to the generator. The analyzer and rectifier are added to remove the water vapour that may have formed in the generator so that only ammonia vapour goes to the condenser. The condenser and evaporator each consist of two sections, to permit extending the condenser below the top of the evaporator and to segregate the freezing portion of the evaporator. A reserve hydrogen vessel is added to give the same efficient under variable load condition.

DESCRIPTION

A 5500rpm, four stroke, water cooled, vertical mount piston type engine was used for the study. The loading is by means of an electrical eddy current dynamometer. The tank is connected to graduated burette to measure the quantity of fuel consumed in unit time. An orifice meter with U-tube manometer is provided along the air on the suction line for measuring air consumption. A five gas analyzer is used to obtain the exhaust gas composition.
All emissions like Carbon monoxide, Carbon dioxide, Un-Burnt Hydrocarbons, Nitrogen oxide and unused oxygen are found with the help of five gas emission analyzer. In this setup, one end of the cable is connected to the inlet of the analyzer and the other end is connected at the end of the exhaust gas outlet.

CONCLUSION

The Suitability analysis of a 5500rpm, four stroke, water cooled, vertical mount piston type SI engine have been performed. The steady-state tests were conducted by varying the engine torque and speed. Afterwards, the exhaust gas flow rate, brake thermal efficiency and specific fuel consumption for each test were determined using experimental data.

Finally, various performance parameters of the engine were evaluated and compared with each other.

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