Analysis and Investigation of Solar Vapour Absorption Refrigeration System

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***Abstract*—The conventional refrigeration technologies as they affect the ozone layer and increase the global warming. The ordinary refrigerator contains the CFCs or HFCs. This is the environmentally destructive and causes the greenhouse effect. It leads to increases the demand of energy consumption. The commercial refrigerator operates in a compression refrigeration cycle, in which the compressor is used to compressing the refrigerant liquid for cooling purpose. In conventional type the compressor is run by using electricity it increases the demand of power consumption. To over the above demand, the compression cycle is replaced by absorption cycle. In this type the generator is receive the heat from solar energy (Renewable energy). This paper deals with the analyze of ammonia solar vapour absorption refrigeration for a single flat plate collector. This technique is combined with vapour absorption refrigeration system to increase the refrigeration effect.**

***Keywords*- Solar energy, flat plate collector, Vapour absorption refrigeration, COP, Ammonia-water.**

I. INTRODUCTON

Solar energy is a very large limitless source of energy. The power from the sun intercepted by the earth is approx. 1.8 × 1011 MW, which are many thousands of time larger than the present consumption rate on the earth of all energy sources. A refrigeration system is a system which can reduce the temperature or heat of a substance Refrigeration is defined as the process of achieve and maintain a temperature below the atmospheric temperature, the aim of refrigeration is to cool some product or space to the required temperature. The work of heat transfer is driven by mechanical work energy, but can also be driven by magnetism, heat, laser, electricity or other means. Refrigeration has many applications, including industrial freezers, household refrigerators, cryogenics, and air conditioning. Most of these refrigerators are operated by using electricity. The major share of electricity that is being supplied with a refrigerator is consumed by the compressor. If refrigerator is operated 24 hours a day, there is huge energy consumption. Also the refrigerants used in these refrigerators are environmentally dangerous. The Freon gases that are popularly used in compression refrigerators are affecting ozone layer and result to global warming. The above stated problems are minimizing by the replacement of compressor system with vapour absorption system. Naturally available materials like ammonia or water can be used as refrigerants instead of the Freon gases. Vapour absorption system is energized by providing heat energy to the generator. Low grade thermal energy can serve this purpose. Solar energy will be an excellent alternative in this case. In vapour absorption refrigeration systems one of the mixtures Ammonia and Water is suitable where thermal energy such as solar energy and. The main part of the device is an absorber/ desorber unit which is mounted inside a concentrating solar collector. The refrigerant is ammonia. Performance of the solar refrigeration unit was measured in a ANSYS and field work. In the present paper, an attempt is made to estimate the refrigeration effect with solar vapour absorption system using solar water heating flat plate collector device.

II. EXPERIMENTAL SETUP

The experimental setup consists of two circuit as following.

1. Solar water heating circuit
2. Vapour absorption refrigeration circuit

A. Solar water heating circuit

The solar water heating circuit is nothing but the solar flat plate collector is used to heating the water. The heat is taken from the sun light. It consist of glassing covers, copper tubes, absorber plate etc. Solar flat plate collectors are special kind of heat exchanger that transform solar emission energy to internal energy of transfer medium. This device absorbs the solar radiation, converts in to the heat and transfer this heat to fluid flowing through the collector. The fluid is passing through the copper tubes. The heat is transfer from absorber plate to the copper tube. The fluid taken this heat from solar energy and get heated. Then the hot water is passed to the storage reservoir.

B. Vapour absorption refrigeration circuit

It consist of components are generator, condenser, expansion valve, evaporator, absorber. Generator is nothing but a cylinder made up of MS material. Inside the generator, the hollow helical coil is provided. The outlet of the generator is connected to the condenser inlet. Condenser is made up of MS pipe which is in coiled shape. Condenser is a device used to condensate a substance from its gaseous to its liquid state, by cooling it. Other end of the condenser is connected to the expansion valve. Expansion valve is a element in refrigeration system that control the amount of refrigerant flow to the condenser there by controlling the super heating at the outlet of the evaporator. Evaporator is a made up of MS pipe which is wounded in coil shape. The evaporator is located in a box which contains water. At inside box the refrigeration effect produced. Capillary tube is connected to the inlet of the evaporator. Evaporator's outlet is connected to the absorber. Absorber is a cylinder which is made up of MS. It also has a provision to pour aqua ammonia solution which is later closed with a valve after filling the absorber. The absorber's outlet is connected to the pump. The pump is a device used to pumped the ammonia solution in high pressure to the generator.

III. WORKING PRINCIPLE

A.Hot water circuit

First filled the cold water in entire circuit of solar panel riser pipes, collecting tank and generator coil. The entire system is placed in atmosphere. In a solar panel the absorber plate receives the solar radiation and transfer heat to the water in risers pipes. As a outcome the water is heated and the density decreases. As the density of hot water is less when compared to the cold water. Automatically hot water rises up and enters the collecting tank. In the riser pipes the hot water is replaced by cold water from collecting. The hot water is circulates in the coil placed in the generator where the hot water gives its heat to the refrigerant. So in the hot water circuit the water receives heat from the solar panel and gives the heat in the generator.

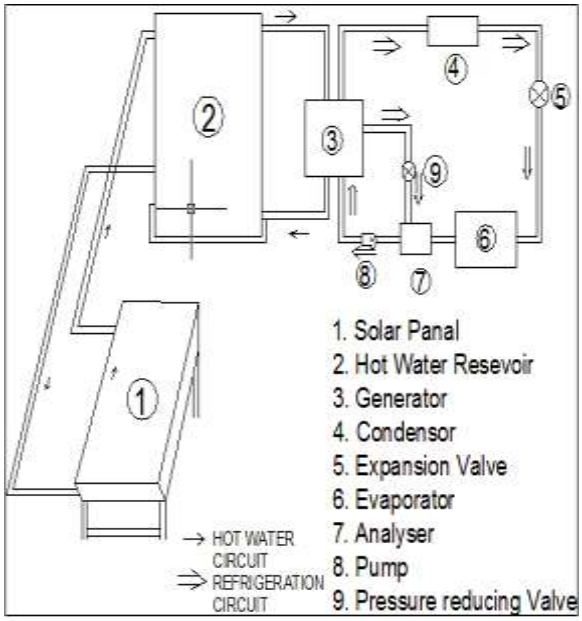

Fig 1. Experimental setup of solar absorption refrigeration system

B. Refrigerant circuit

The ammonia placed in generator absorbs heat from the hot water in in generator coil. The ammonia after getting vaporized. The ammonia vapour is send to the condenser. In the condenser the ammonia vapour gives off its heat to the surrounding and converted into liquid ammonia. The liquid refrigerant then enters to the capillary tube where the pressure drops to the evaporator pressure. The low pressure low temperature liquid refrigerant is passed to the evaporator. In a evaporator the liquid refrigerant receives heat and produces the refrigerating effect in the evaporator cabinet. The refrigerant get converts in to vapour. In the absorber the ammonia vapour mixed with water placed in the absorber. This is due to the chemical affinity of the water towards ammonia. This is the motive force for the refrigerant. In the absorber the ammonia vapour mixes with water and converted ammonia as aqua ammonia solution. This solution is pumped to the generator at a high pressure by HP pump. In the generator the ammonia gets vaporizes and separates from the solution. If any amount of ammonia remains in the solution it is sent back to the absorber through capillary tube. Thus the cycle repeats.In the generator the ammonia gets vaporizes and separates from the solution. If any amount of ammonia remains in the solution it is sent back to the absorber through capillary tube. Thus the cycle repeats.

IV. RESULTS AND DISCUSSION

From the single flat plate solar collector, the high temperature of hot water to the generater increases and the evaporator temperatures at inlet and outlet are decrease. It is also observed from the Fig the difference between evaporator temperatures at inlet and outlet marginally increases as the time of operation increases. The temperature drop is found that in the range of 7 to 80C. Almost after twohours of operation there is no further drop is observed and it may be due to there is no change in supply water temperature to the generator.

V. CONCLUSION

The following conclusions can be made from the presentinvestigation

- The Solar flat plate collector Water Heater (SWH) can be effectively used in summer to produce refrigeration effect using vapour absorption refrigeration cycle.
- The amount of refrigeration effect is based on the temperature of the hot water supplied to the generator.
- The maximum drop in the temperature at the evaporator in the present work is estimated to be7 to 80C.

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