Fabrication & Analysis Of Vapor Absorption Refrigerator Working On Solar Heat

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Abstract - There are some environmental concerns regarding the use of conventional refrigeration technologies as they contribute to ozone layer depletion and global warming. Refrigerators that contain CFCs, HCFCs or HFCs in their refrigerant cycle or insulation foam are very harmful. All these are environmentally destructive and potential global warming chemicals. Also, there is an energy concern regarding the use of commercially available refrigerators. The commercial systems operate in a vapor compression cycle, in which a compressor does the major work of compressing the refrigerant liquid for cooling. As the refrigerators are usually operated for 24 hours a day, there is considerable energy consumption. The use of solar energy to power refrigeration with replacing the compression cycle with vapor absorption cycle strives. To minimize the negative impacts refrigerators have on the environment and energy. Replacing the electrical energy with solar energy will reduce the consumption of high grade electrical energy. Also the replacement of compression system with absorption system eliminates. The energy consumption by compressors. Ammonia being an environmentally friendly gas reduces the effect of ozone layer depletion and global warming by artificial refrigerants. This paper deals with a model solar refrigeration system using NH3-H2O vapor absorption system.

KeyWords: Vapor absorption1, solar energy2, Refrigerator3, Ammonia-Water4

1 INTRODUCTION

Solar energy is a very large, inexhaustible source of energy. The power from the sun intercepted by the earth is approximately 1.8 ×1011 MW which is much larger than the present consumption rate on the earth of all commercial energy sources. Thus, in principle, solar energy could supply all the present and future energy needs of the world on the continuing basis. This makes it one of the most promising of the unconventional energy sources. In addition to its size, solar energy has two other factors in its favor.

Energy is the primary and the most universal kind of work by human beings and nature. Most people use the word energy for input to their bodies or to the machines and thus think about crude fuels and electric power.

The fossil fuels are used to produce thermal power; and according to the prediction they will be exhausted in the near future. Therefore there is a need to use non-conventional and renewable source of energy. And these forms of energy are being used by several countries. These energy are solar, wind, sea, geothermal and bio mass which are available in plenty. Also these energy are cheap and eco-friendly too.

2. LITERATURE REVIEW

Jasim et al. (2007) performed a thermodynamic analyses for different working fluid pairs. A computer simulation model has been developed to predict the performance of solar absorption refrigeration system using different working fluid. Detailed thermodynamic properties for ammonia- water, ammonia-lithium nitrate and ammonia-sodium thiocyanate are expressed in polynomial equations and used in cycle simulation. The performances of these three cycles against various generator, evaporator, and condenser temperatures are compared. The results show that the ammonia-lithium nitrate and ammonia-sodium thiocyanate cycles give better performance than the ammonia-water cycle. Syed et al.(2012) proposed an alternate designs for a 24-h operating solar powered absorption refrigeration technology. The development includes an in-depth review of the design and operation of the conventional and solar-assisted absorption refrigeration systems coming-up with new alternative designs, detailed thermodynamic analysis of some of the new alternative designs and selection of the most suitable alternative design. The analysis indicates that continuously operating solar-powered aqua-ammonia absorption system with refrigerant storage is the most suitable alternative design for an uninterrupted supply of cooling effect.

3. DESIGN DETAILS

GENERATOR/ RECEIVER

Material of generator box is stainless steel. The dimensions we used for making generator are given below:

Length of generator = 200 mm
Width of generator =150 mm
Height of generator = 150 mm
Capacity of generator = 0.20*0.15*0.15
$= 4.5*10^{-3}*1000$
=4.5 liters

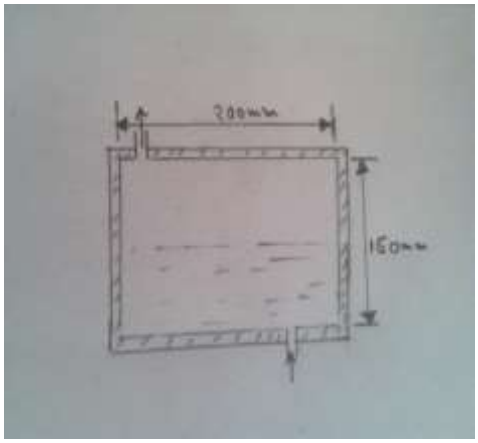

Fig. Design of Generator/ receiver

Fig. Generator/ Receiver

CONDENSER

Condenser is made up of mild steel. There are lot of fins provided on the condenser tube.

Dimension of condenser is:

No. of tubes	= 9
Radius of circular edges	=10 mm
Length of Circular edge	= 2πr
	= 2*3.16*10
	= 63.2 mm
Total no. of circular edges	= 8
Total circular length	= 63.2*8
	=485.6 mm
Straight length of tube	= 21.5
Straight length of tube	= 21.5*9
	= 193 mm

Total length of Heat exchanger / condenser = 485.6 + 193 = 642.3 mm

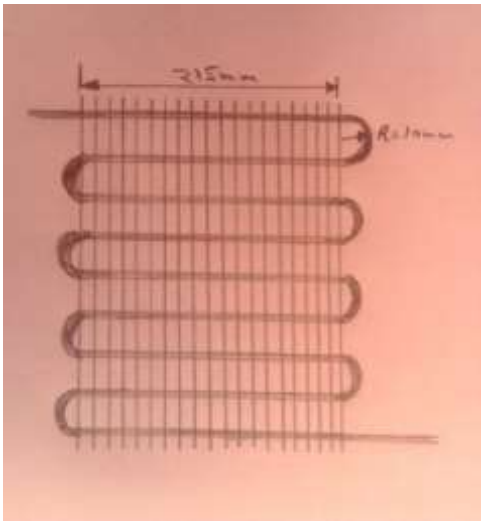

Fig. Design of condenser

Fig. Condenser

CAPILLARY TUBE/ EXPANSION VALVE

The material used for making Capillary tube is stainless steel. The length of capillary tube is mm. And the diameter of Capillary tube is mm.

Fig. Capillary tube/ Expansion valve

EVAPORATOR

Length of evaporator tube is 3000 mm and the diameter of evaporator tube is 9.55 mm.

Fig. Evaporator

ABSORBER

The materials used for making absorber are PVC Pipe, mild steel pipe and a Pump for spraying water on vapors

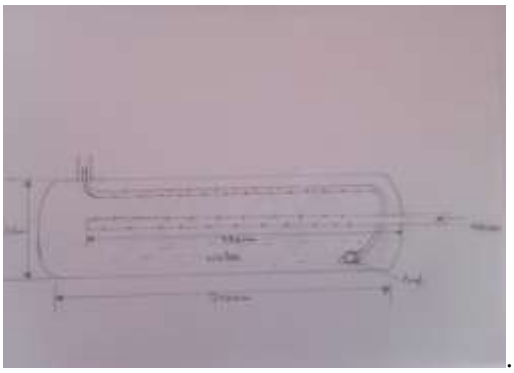

Fig. Design of absorber

3. CONCLUSIONS

The future of solar refrigeration and air conditioning seems to be a very good proposition and no doubt will find its place in future industrial applications. The major limiting factor at present is the shape of energy so as to make it available whenever it is required, for example at nights and extended cloudy days when we cannot attain a high enough temperature.

In the case of air conditioning and refrigeration, storage can either be done in the form of heat or as the final product (cold water or ice). The latter is a much easier form of storage but it is rather bulky, for this reason there has been ongoing research in the area of storage in various forms, trying to make use of phase change materials, eutectics, oils, etc., which has the potential of storing large quantities of energy within a small space and over a longer period of time than water. With the achievements already made in this field, the technology will no doubt be available for large scale application in the near future. Coupled with a more elaborate design of the refrigeration system that we had designed we could go far way in supplementing solar energy for the conventional energy used for these prices today. The optical efficiency can be improved by keeping the reflector clean and polished. The joints of all the components with each other should be of good because leakage of ammonia is not good for human health

4. SCOPE FOR FUTURE WORK

The following work may be carried out to increase the performance of the refrigeration system:

1. For increasing the concentration ratio, provide the suitable tracking system equipped with sensors.
2. The mirrors used in the parabolic dish should be casted in 6 pieces for the entire cross-section area of parabolic dish.

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