A Review on Experimental Analysis Libr-H2O Vapor absorption refrigeration using Concentric type Solar Collector

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Abstract-For the last two centuries, fossil fuel has been considered and utilized as the main source of energy. However; the negative impacts of burning fossil fuel on the environment have forced the energy research continuity to seriously consider renewable sources of energy. Solar energy, in particular, has been the main focus in this regard because it is a source of clean energy and naturally available. Solar energy applications include solar photovoltaic and solar thermal. Solar thermal systems are used to power absorption refrigeration and air-conditioning systems. This paper work indicates the experimental investigation of a small capacity of vapor absorption cooling system. With the development in the field of refrigeration, cooling and heat transforming systems, the vapor absorption cycle has gained renewed interest due to environmental and electricity availability problems of commonly used refrigerants in vapor compression system. The most common absorbent-refrigerant pair is LiBr-H2o. It is the most popular choice in absorption cooling. A small capacity vapor absorption system is first analyzed and characteristics at various points are measured. Components like absorber, evaporator, condenser and generator are used. Energy consumption and energy savings in terms of energy and fuels are calculated. The Overall heat transfer coefficient, effectiveness and COP of the vapor absorption refrigeration are measured.

Index Terms - Vapor absorption, water/Li-Br refrigerant, Performance evaluation, solar collector.

I. INTRODUCTION

An absorption refrigeration system uses heat source to provide the energy needed to drive the cooling system. Absorption refrigeration system is a popular alternative to regular compressor refrigeration system where electricity is unreliable, costly or unavailable, where noise from the compressor is problematic or where surplus heat is available. In hot climates, the heating and cooling demand of domestic dwellings can be reduced substantially with various measures such as good insulation, double glazing, use of thermal mass and ventilation. As the temperature in summer is very high, the cooling demand cannot be reduced to thermal comfort level by low energy cooling techniques. So an active cooling system is required. Such system is preferable because it is not powered by electricity. Its production totally depends on fuel. The overall performance of an absorption refrigeration system is greatly affected by the characteristics of heat and mass transfer in the absorber where the refrigerant vapor is absorbed into the absorbent. The refrigeration capacity of an absorption refrigeration engine is limited by the absorption ability of the absorbent solution. In other words, for a given amount of absorbent solution in the machine, its duty is directly determined by the amount of refrigerant that it can absorb.

The working fluid in an absorption refrigeration system is a binary solution consisting of refrigerant and absorbent. In Fig. 1(a), two evacuated vessels are connected to each other. The left vessel contains liquid refrigerant while the right vessel contains a binary solution of absorbent/refrigerant. The solution in the right vessel will absorb refrigerant vapor from the left vessel causing pressure to reduce. While the refrigerant vapor is being absorbed, the temperature of the remaining refrigerant will reduce as a result of its vaporization. This causes a refrigeration effect to occur inside the left vessel. At the same time, solution inside the right vessel becomes more dilute because of the higher content of refrigerant absorbed. This is called the "absorption process". Normally, the absorption process is an exothermic process; therefore, it must reject heat out to the surrounding in order to maintain its absorption capability. Whenever the solution cannot continue with the absorption process because of saturation of the refrigerant, the refrigerant must be separated out from the diluted solution. Heat is normally the key for this separation process. It is applied to the right vessel in order to dry the refrigerant from the solution as shown in Fig. 1(b). The refrigerant vapor will be condensed by transferring heat to the surroundings. With these processes, the refrigeration effect can be produced by using heat energy. However, the cooling effect cannot be produced continuously as the process cannot be done simultaneously. Therefore, an absorption refrigeration cycle is a combination.

Separation process occurs in the right vessel as a result of additional heat from outside heat source. of these two processes as shown in Figure As the separation process occurs at a higher pressure than the absorption process, a circulation pump is required to circulate the solution. The work input for the pump is negligible relative to the heat input at the generator; therefore, the pump work is often neglected for the purposes of analysis.

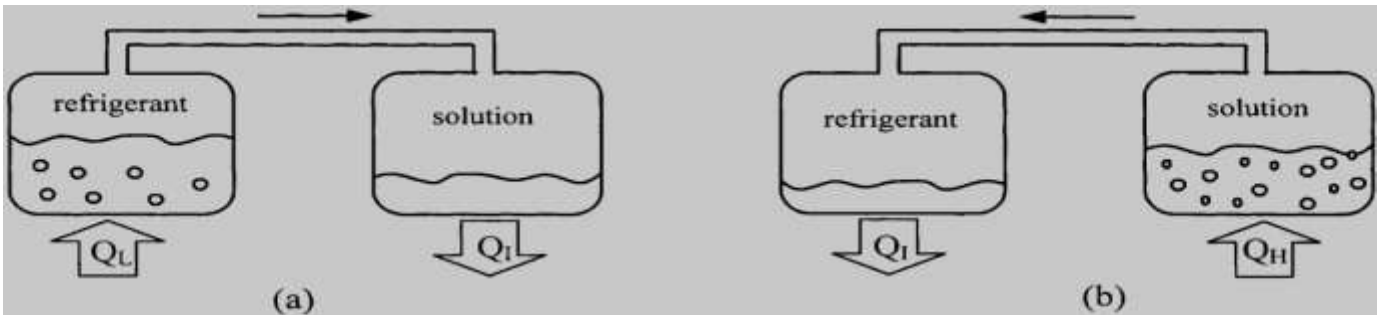

Fig. 1(a): Absorption process occurs in right vessel causing cooling effect in the other;

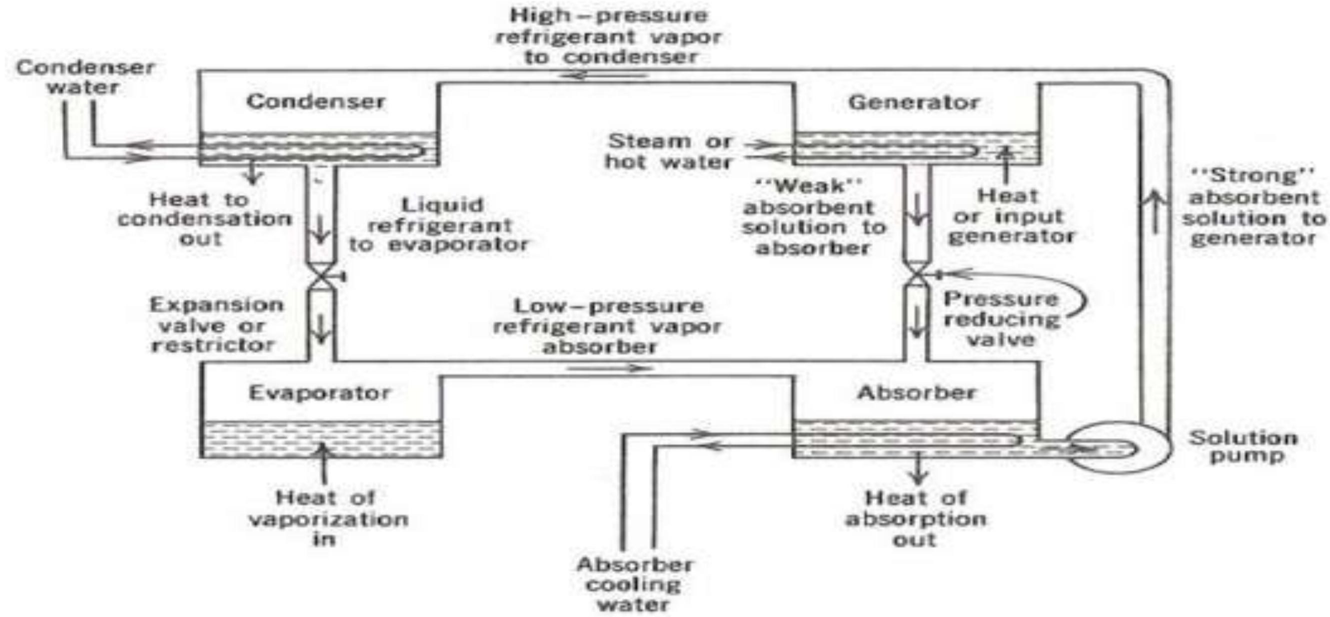

Fig. 1(b): Refrigerant. Fig. 2: Schematic diagram of absorption refrigeration system

II. LITERATURE REVIEW

Mohd Aziz Ur Rahaman, Md.Abdul Raheem Junaidi, Naveed Ahmed, Mohd.Rizwan[1] "Design and Fabrication of Vapour Absorption Refrigeration System[Libr-H20]" Most of the energies are utilized by the industries due to depletion of fossil fuels and increasing the fuel price to exploit the maximum presented energy from the waste heat source. The industry which utilizes steam turbine exhaust carries a considerable amount of thermal energy. This energy can be set in to positive use as a heat source for vapor absorption system to serves as cooling system. This paper illustrates the thermal and fiscal advantages of using single effect lithium bromide water absorption by means of waste heat. The objective of this work is to hypothetical design of lithium bromide water absorption Refrigeration system using waste heat from any industry steam turbine exhaust. The various parts of the vapor absorption system are absorber, solution heat exchanger, evaporator, condenser and generator. Energy consumption and energy savings in terms of energy and fuels are calculated. The Overall heat transfer coefficient, effectiveness and COP of the heat exchanger are measured. The energy and global warming crises have drawn rehabilitated benefit to thermally driven cooling systems from the air conditioning and process cooling fraternities. The lithium bromide- water absorption refrigerator is one of the favorites due to the following specific reasons it can be thermally driven by gas, solar energy, and geothermal energy as well as waste heat, which help to substantially reduce Carbon dioxide emission its use of water as a refrigerant it is quiet, durable and cheap to maintain, being nearly void of high speed moving parts its vacuumed operation renders it amenable to scale up applications. LiBr-H_2O absorption refrigerator enjoy cooling capacities ranging from small residential to large scale commercial or even industrial cooling needs. The coefficient of performance (COP) varies to a small extent (0.65-0.75) with the heat source and the cooling water temperatures.

Omar Ketfi, Mustapha Merzouk, Nachida Kasbadji Merzouk, Said El Metenan[2] "Performance of a Single Effect Solar Absorption Cooling System (Libr-H_2O)" In this research paper Fossil fuels are on the verge of depletion, and the world energy consumption is in constant progression, resulting in very serious concerns about environmental issues. Mechanical refrigeration based on vapor compression principle uses high grade electrical energy, and refrigerant fluid with a global worming and ozone depletion potentials. Absorption machines using solar thermal energy are excellent alternatives to mechanical refrigeration. Absorption cooling systems are mature technologies that proved their abilities to provide clean cooling with the use of low grade solar and waste heat. In this paper we presented a modeling and simulation study of a 70 kW Yazaki absorption cooling machine working with water-lithium bromide mixture. The influence of different parameters (Heat exchanger efficiency, Generator, absorber and condenser temperatures) on the system performance is showed.

Jason Wonchala, Maxwell Hazledine, Kiari Goni Boulama[3] "Solution procedure and performance evaluation for a water-LiBr absorption refrigeration machine" The water-lithium bromide absorption cooling machine was investigated theoretically in this paper. A detailed solution procedure was proposed and validated. A parametric study was conducted over the entire admissible ranges of the disrober, condenser, absorber and evaporator temperatures. The performance of the machine was evaluated based on the circulation ratio which is a measure of the system size and cost, the first law coefficient of performance and the second law exergy efficiency. The circulation ratio and the coefficient of performance were seen to improve as the temperature of the heat source increased, while the second law performance deteriorated. The same qualitative responses were obtained when the temperature of the refrigerated environment was increased. On the other hand, simultaneously raising the condenser and absorber temperatures was seen to result in a severe deterioration of both the circulation ratio and first law coefficient of performance, while the second law performance indicator improved significantly. The influence of the difference between the condenser and absorber exit temperatures, as well as that of the internal recovery heat exchanger on the different performance indicators was also calculated and discussed.

Z.Y. Xu, R.Z.Wang[4] "Experimental verification of the variable effect absorption refrigeration cycle "in this paper, a variable effect absorption refrigeration cycle is proposed which can obtain a rising COP (Coefficient of Performance) versus the rising generation temperature. This novel cycle could be applied for solar absorption cooling efficiently. In this paper, a 50 kw variable effect (also named as 1.n effect) absorption chiller using LiBr-water as working fluid was designed. Its rated condition is generation temperature of 125°C, condensation temperature of 40°C, absorption temperature of 35°C and evaporation temperature of 5°C. The variable effect absorption chiller was then manufactured and tested. Data from the experiment showed that the chiller can get a rising COP from 0.69 to 1.08 under generation temperature from 95°C to 120°C as it was expected. The average error between theoretical COP and experimental COP was 7.3%. Feasibility of the variable effect absorption chiller and the effectiveness of the design have been verified.

Dazhi Yu, Jacob Chung, Saeed Moghaddam[5] "Parametric study of water vapor absorption into a constrained thin film of lithium bromide solution" This study presents a two-dimensional numerical simulation of a membrane-based absorber. A comprehensive parametric study is performed to quantify the influence of different operational and geometrical parameters such as solution film thickness, velocity, and concentration, cooling water temperature, and membrane thickness, pore size, and porosity on the absorption rate. In addition, the effect of membrane surface roughness on the absorption rate is investigated. The results indicate that the most critical parameters that affect the absorption rate are the solution film thickness and velocity. While it is impossible to control these parameters in dependently in a conventional absorber, they can be readily adjusted in the proposed membrane-based absorber to achieve the optimal performance. The simulation results suggest up to 3-fold enhancement in the absorption rate when a solution film thickness in the range of 50–100l misused.

F. Asdrubali, S.Grignaffini[6] "Experimental evaluation of the performances of a H_2O–LiBr absorption refrigerator under different service conditions "The paper describes an experimental plant aimed at simulating and verifying the performances of a single-stage H_2O–LiBr absorption machine. The machine is water cooled and it is supplied by hot water produced by an electrical boiler; it is possible to simulate different service conditions by varying the temperatures and the flow rate of water in the external circuits. Measurement facilities allow recording in real time all the main operating parameters of internal and external circuits (temperatures, pressures and flow rates). The paper illustrates the characteristics of the machine and of the plant and the results of various experimental campaigns. In particular, the acquisitions on the plant have tested different service conditions by varying the flow rate and the temperature of the supplying hot water; the energy and energy performances of the plant are presented and compared with data from literature and from a simulation code developed for the plant.

III. CONCLUSION

From literature review it could concluded that,

1. The COP of the system depends on generator temperature and there is optimum value of generator temperature at which COP is maximum.

2. For a given refrigerating capacity higher generator temperature causes high cooling ratio with smaller heat exchange surface and low cost.

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