EFFECT OF APPROCHING TEMPERATURE ON THE PERFORMANCE AND SIZE OF LiBr-WATER VAPOUR ABSORPTION REFRIGERATION IN THE ABSENCE OF SOLUTION HEAT EXCHANGER

Sunil.B.S[1], Manu S[2], C.V.Mahesh[3], T.K.Chandrashekar[4]

[1] M.Tech, 4th sem Mechanical Engineering, SSIT, Tumkur.
[2]Assistant Professor, Department of Mechanical Engineering, SSIT, Tumkur
[3]Professor, Department of Mechanical Engineering, SSIT, Tumkur
[4]Professor, Department of Mechanical Engineering, MIT, Moodabidri

Abstract

In this study, a detailed thermodynamic analysis of the water/lithium bromide absorption refrigeration cycle is performed. The influences of approaching temperatures, conductance and coefficients of performance are investigated. Plots of coefficients of performance and conductance are shown against approaching temperatures of the system. It is concluded that the performance and conductance decreases with increase in approaching temperature of all the components.

Keywords: *Refrigeration, Absorption, Water/Lithium bromide.*

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1. INTRODUCTION

During the recent years research has attempted to develop new technologies that can reduces energy consumption and cost without decreasing the level of comforts. By this reason absorption refrigeration technologies has greater advantages compared to conventional refrigeration systems because the system utilises waste heat and it is friendly with environment. Among different combination of refrigerant and absorbent, Lithium Bromide –Water (LiBr-H_2O) showed the promising solution for effective ultisation of waste heat and zero determental effect on the atmospher since it uses water has refrigerant and Lithium-Bromide solution as absorbent

Number of research has been carried out to enhance the performance of the system and reduce the size of the system. A.Kececiler et al. [1] conducted experiments in laboratory on LiBr H2O system which uses low temperature geothermal energy as a powering source. The result showed that, low-heat geothermal sources cannot be used efficiently in electricity generation and effective for the storing range at 4-10ºC. Da-Wen Sun [2] performed simulation on LiBr H2O absorption refrigeration systems. The simulation provides the detailed thermodynamic design data and optimum design map and also for new absorbent/refrigeration pairs. O. Kaynakli et al. [3] investigated the effect of operating temperature on the performance of single effect LiBr H2O absorption refrigeration cycle. The result showed that as the generator and evaporator temperature increases there is a drastic increase of COP (Coefficient of Performance) but decreases with rise of condenser and absorber temperatures. M. Izquierdo et al. [4] performed trials to investigate the performance of a commercial 4.5 kW air cooled, single effect LiBr H2O absorption chillier which is used for residential. The result showed as the cooling power tends to decreases with increase of outdoor dry bulb temperature and for the temperature ranges of 35 to 41.3ºC but the chilled water outlet temperature of evaporator peaks to 15ºC. Mostafavi and Agnew [5] investigated the effect of ambient temperature on the surface area of the component of an air-cooled absorption machine. The objective of the study to investigate the effect of approaching temperature on the performance of single stage water cooled LiBr–water absorption machine. The theoretical simulation is performed using MAT lab Software for the capacity of 0.5kW.

1.1 Approaching Temperature

The approaching temperature refers to the maximum heat transfer for hot body to the cold body. If the approaching temperature is less then greater is the heat transfer. This approaching temperature play key role on the performance of the system because the system is cooled by the water and refrigeration effect is aborbed by the chilled water. There are mainly four approaching temperatures comes in the system and they are as follows:-Approaching absorber temperature (DTa). It is the temperature difference between T12 and T15, Approaching evaporator temperature (DTe), It is the temperature difference between T16and T1, Approaching generator temperature (DTg), It is the temperature difference between T10 and T7.Approaching Condenser temperature (DTc), It is the temperature difference between T14 and T13.

1.2 Circulation Ratio

The circulation ratio (CR) can be defined as the ratio of the mass flow rate of the solution coming from the generator to the absorber to the mass flow rate of the working fluid.

$$CR = \frac{\dot{m}_s}{\dot{m}_{H_2O}}$$

2. VAPOUR ABSORPTION REFRIGERATION (VAR) SYSTEM

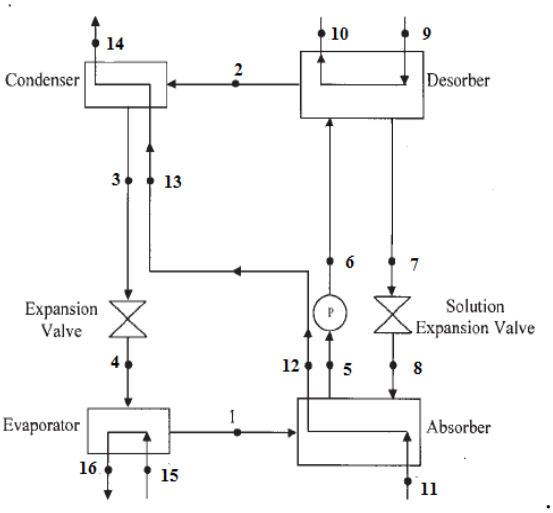

Fig-1: Schematic diagram of LiBr-H_2O vapour absorption refrigeration cycle

The refrigerant is vaporized in the evaporator after taking heat from the water. It is then sent to the absorber where the refrigerant vapours get condensed. During the process, latent heat liberated during condensation of refrigerant vapours is taken by the cooling water in absorber. The weak solution coming from absorber and rich in refrigerant concentration is pressurized through pump upto generator pressure where it is heated to give off refrigerant vapour, forming strong concentration refrigerant solution. This strong concentration refrigerant solution then returns to absorber and mixes with refrigerant vapours coming from evaporator, forming a strong concentration refrigerant solution which is then re-circulated in the circuit. The refrigerant vapours are condensed in the condenser liberating heat of condensation. Throttle valve and expansion valve are used to reduce the pressure of poor concentration refrigerant solution and refrigerant coming out from condenser to absorber and evaporator pressure respectively. The heat is supplied to the generator by hot water. The heat rejected in the condenser is passed to the circulating cold water.

3. RESULTS AND DISCUSSION

3.1 Effect of Approaching Condenser Temperature

Fig-2(a) and (b) shows the variation of condenser approaching temperature on the performance of the system and the conductance. The simulation was performed by varying condenser approaching temperatures for DTa=DTg=DTe=5°C. The Fig 2(a), (b) shows an approaching temperature of condenser increases there is a decrease in the performance and conductance of the condenser. This is due to decrease in the heat transfer rate to the cooling water resulting in decrease in the condensate rate this reduces the performance of the system. Decreasing in the conductance of the condenser is due increase in the condenser temperature.

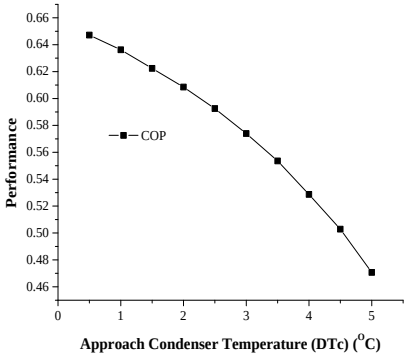

Fig-2(a): Condenser approaching temperature Vs. Variation of performance

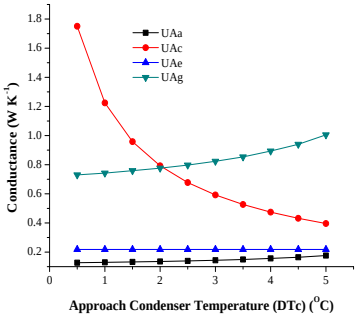

Fig- 2(b): Condenser approaching temperature Vs. Conductance

3.2 Effect of Approaching Evaporator Temperature

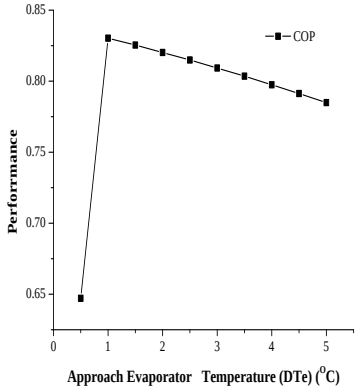

Fig-3(a): Evaporator approaching temperature Vs. Variation of performance

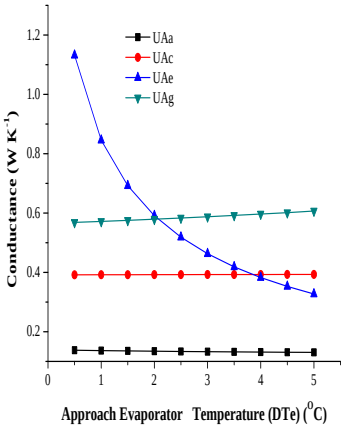

Fig- 3(b): Evaporator approaching temperature Vs. Conductance

Fig-3(a) and (b) shows the variation of evaporator approaching temperature on the performance of the system and the conductance. The simulation was performed by varying evaporator approaching temperatures for DTa=DTg=DTc=5°C.The Fig-3(a) and (b) shows an approaching temperature of evaporator increases there is a decrease in the performance and conductance of the evaporator. This is due to decrease in the heat transfer rate to the water resulting in decrease in the evaporation rate of refrigerant resulted in reduction in the performance of the system. Decreasing in the conductance of the evaporator is due increase in the evaporator temperature.

3.3 Effect of Approaching Generator Temperature

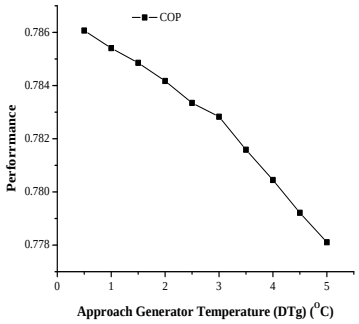

Fig-4(a): Generator approaching temperature Vs. Variation of performance

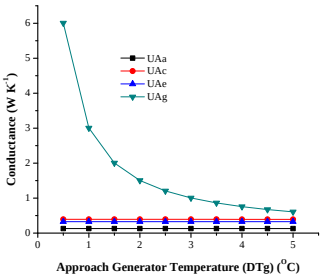

Fig- 4(b): Generator approaching temperature Vs. Conductance

Fig-4(a) and (b) shows the variation of generator approaching temperature on the performance of the system and the conductance. The simulation was performed by varying generator approaching temperatures for DTa=DTe=DTc=5°C. The Fig 4(a) and (b) shows an approaching temperature of generator increases there is a decrease in the performance and conductance of the generator. This is due to decrease in the heat transfer rate to the cooling water resulting in decrease in the generation rate of refrigerant this reduces the performance of the system. There is a drastic decreasing in the conductance of the generator is due increase in the generator temperature.

3.4 Effect of Approaching Absorber Temperature

Fig-4(a) and (b) shows the variation of absorber approaching temperature on the performance of the system and the conductance. The simulation was performed by varying absorber approaching temperatures for DTe=DTg=DTc=5°C. The Fig 4(a) and (b) shows an approaching temperature of absorber increases there is a decrease in the performance and conductance of the absorber. This is due to decrease in the heat transfer rate to the cooling water resulting in decrease in the circulation rate this reduces the performance of the system.

There is a low decreasing in the conductance of the absorber is due increase in the absorber temperature.

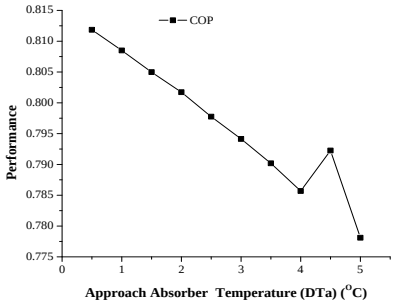

Fig-5(a): Absorber approaching temperature Vs. Variation of performance

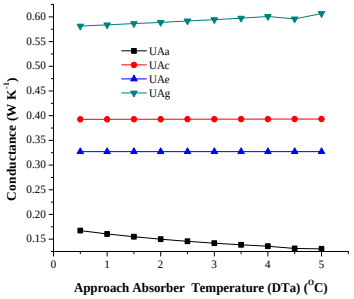

Fig- 5 (b): Absorber approaching temperature Vs. Conductance

4. CONCLUSIONS

The theoretical simulation was performed on single effect water cooled vapour absorption refrigeration. The simulation is carried on MAT Lab software by varying approaching temperature. The paper concludes that as approaching temperature increases in condenser, evaporator, absorber, generator there is a decrease in the performance and conductance.

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