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EFFECT OF CONCENTRATION OF LITHIUM BROMIDE MIXTURE ON COP FOR SINGLE EFFECT LiBr-H_2O ABSORPTION REFRIGERATION SYSTEM

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Abstract— In this paper effect of concentration of lithium bromide mixture on Co-efficient of performance (COP) for single effect LiBr-H_2O absorption chillers is calculated. Then find out how the cop varies with the concentration of lithium bromide. For finding cop temperature of condenser varies and the other parameter (temperature of generator, temperature of absorber, capacity of evaporator, temperature of evaporator temperature of absorber) remains constant. Optimal value of COP obtained 0.65 varying temperature of condenser.

Keywords- Absorption System; Lithium Bromide; COP; Concentration of lithium bromide; condenser

I. INTRODUCTION

In recent years, special attention has been paid to absorption refrigeration systems (ARSs) because of their low cost and environmentally friendly operation. In comparison to conventional mechanical vapor compression refrigeration systems, ARSs require lower energy level, therefore renewable energy sources or heat wasted by industrial processes can be used to operate such systems.

Different methodologies have been developed for improving ARSs. Generally single effect chillers are the most common type on market. Single effect absorption refrigeration system have been studied by number of others (Gomri, Kaushik and arora), they analyzed cycles both energetically and exergetically. The condensation temperatures used in their simulation for calculating enthalpy and entropy.

II. SYSTEM DESCRIPTION

Fig shows the schematic diagram of a single effect VARs, which uses water as refrigerant and lithium bromide as absorbent. For this purpose of analysis following assumption are made:

- Refrigerant water at condenser and evaporator exit is in saturated states.
- Lithium bromide solutions in the generator and absorber are assumed to be in equilibrium conditions at their respective temperature and pressure.
- Strong solution of refrigerant leaving the absorber and weak solution of refrigerant leaving the generator are saturated.
- The reference environmental state for the system is water at an ambient temperature (T_0) of 25^0C.
- Pressure drop in pipes and other components are negligible.
- All components are externally adiabatic.

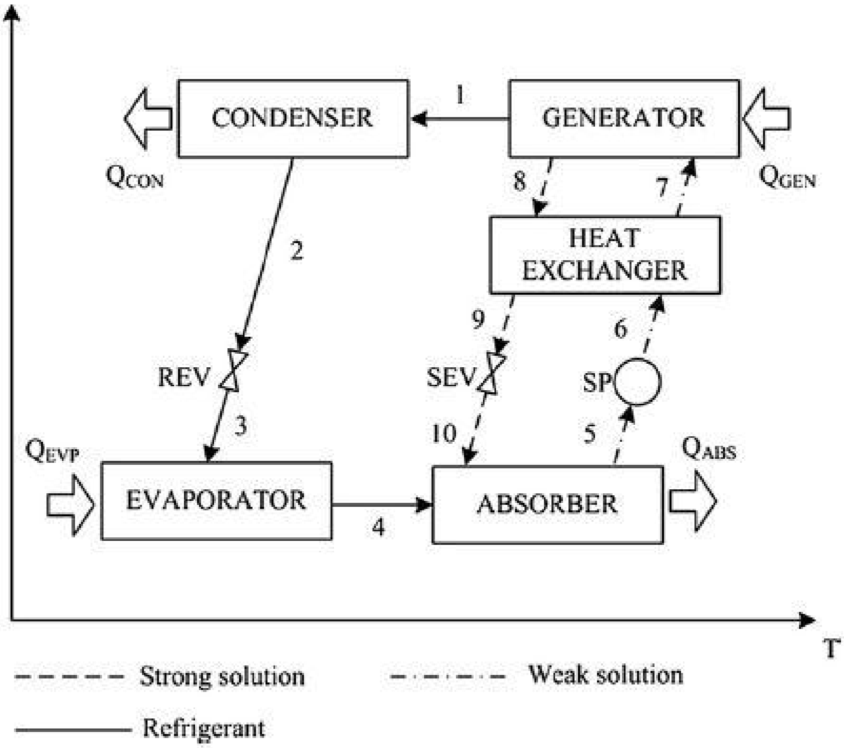


Fig. 1. Schematic diagram of a single-effect LiBr–H_2O ARS.

2.1 Desirable Properties of Refrigerant-Absorbent mixtures:

Refrigerant-absorbent mixtures for Vapour Absorption Cooling System should possess some desirable properties like the refrigerant should be more volatile than the absorbent in other words the boiling point of refrigerant should be much lower than the absorbent. There must be large difference in the boiling points of refrigerant and absorbent (greater than 2000 0C), so that the solution in the Generator need only to be heated to the temperature required to boil off only the refrigerant. This ensures that only pure refrigerant circulates through refrigerant circuit (condenser-expansion valve-evaporator). The refrigerant should exhibit high solubility with solution in the absorber. The absorbent should have strong affinity for the refrigerant. This will minimize the amount of refrigerant to be circulated. Operating pressures should be preferably low, so that the walls of the shells and connecting pipes need not to be thick. It should not undergo crystallization or solidification inside the system. Because crystallization will block the free flow of solution in the line. The mixture should be safe, chemically stable, noncorrosive, inexpensive and should be available easily. The refrigerant should have high heat of vaporization.

III. THERMODYNAMIC ANALYSIS OF THE SYSTEM

Form fig-1 schematic diagram of single effect LiBr-H_2O system following equations are used.

Let M= mass of refrigerant, kg/s

M_{ss}= mass flow rate of strong solution, kg/s

M_{ws}= mass flow rate of weak solution, kg/s

3.1 Mass (m) and Heat transfer (Q) balance for each component:

Condenser:

$M_1=M_2=M$

$Q_C= M*(h_1-h_2)$

Expansion Valve:

$M_2=M_3=M$

$h_2=h_3$

Evaporator:

$M_3 =M_4=M$

$Q_e=M*(h_3-h_4)$

Absorber:

From total mass balance

$M+M_{ss}=M_{ws}$

Circulation Ratio:

$\lambda=M_{ss}/M$

$M_{ws}= (1+\lambda)*M$

$\lambda=\xi_{ws}/(\xi_{ss}-\xi_{ws})$

$Q_a=M*h_4+M_{ss}*h_{10}-M_{ws}*h_5$

Solution Pump:

$M_5=M_6=M_{ws}$

Solution Heat Exchanger:

$M_6=M_7=M_{ws}$

$M_8=M_9=M_{ss}$

$M_{ws}*(h_7-h_6)=M_{ss}*(h_8-h_9)$

Generator:

$Q_g=M*h_1+M_{ss}*h_8-M_{ws}*h_7$

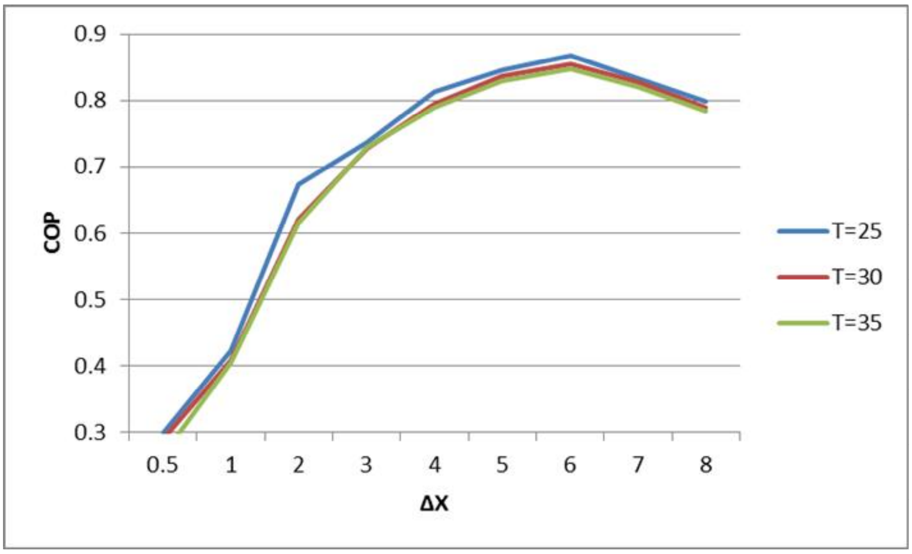
COP=Q_e/Q_g

IV. RESULTS

The parameter chosen as reference to optimize VAR system operation and maximize COP varies with the solution concentration ΔX.

Where $\Delta X=\xi_{ss}-\xi_{ws}$ is most suitable choice as the reference variable for optimizing COP.

- Temperature of Evaporator **T_E=5°C**
- Capacity of Evaporator **Q_E=7.5 Kw**
- Temperature of Absorber **T_A=20°C**
- Temperature of Generator **T_G= 64°C**
- Temperature of condenser **T_C= 25°C , 30°C** respectively



IV.CONCLUSION

In this method effect of condensation and desorption temperatures on COP and particularly effect of the variation in solution concentration Δx were studied. The method proposed for maximize COP for single effect LiBr-H_2O absorption system is correct. In single effect LiBr-H_2O the maximum COP for T_C of 25°C, 30°C and35°C is reached when Δx is 6.5% and 7% respectively within the crystallization effect.

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