ABSTRACT

Information on the performance of absorption refrigeration cycles for generation temperatures normally achieved with flat-plate solar-collector temperatures is scarce. This study, therefore, evaluates the performance of absorption refrigeration cycles with a view to determining optimum operating conditions for use with flat-plate solar-collectors.

Equations for the thermodynamic performance analysis of the ammonia-water absorption refrigeration system are formulated and solved, using available equilibrium thermodynamic property equations. Equilibrium thermodynamic property equations for the water-lithiumbromide pair are developed and used to extend the performance analysis to the water-lithiumbromide absorption cycle. It is further suggested that similar equations can be obtained to describe the equilibrium thermodynamic properties of other refrigerant-absorbent pairs provided the relevant thermodynamic data is available. This simplifies the analysis of absorption-refrigeration cycles.

The results of the thermodynamic performance analysis of the ammonia-water and water-lithiumbromide absorption cycles show that as the condensing and absorbing temperatures are lowered, the coefficient of performance, COP, is improved and that the improvement in COP for decreasing condenser/absorber temperatures is significant only for generation temperatures below about 80^{o}C. Comparison of the performance of the two cycles, for similar operating conditions, shows a higher value of COP for the water-lithiumbromide absorption cycle. Furthermore, the 'cut-off' for the water-

lithiumbromide cycle occurs at a slightly lower generation temperatures than for the ammonia-water cycle.

The analysis of the overall coefficient of performance of a flat-plate solar-collector driven ammonia-water absorption system shows that optimum thermal performance may be achieved for generation temperature in the range 65-90^{o}C. This incidentally is also the practical operational temperature range of the present-day state-of-the-art flat-plate solar-collectors, the actual temperature of operation being determined by the condenser, absorber and evaporator temperatures.

Optimum thermal performance of the flat-plate solar-collector driven ammonia-water absorption system over the day, in Trinidad, is achieved at a generation temperature of about 75^{o}C for a condenser/absorber temperature of 30^{o}C and evaporator temperature of 3^{o}C. The optimum performance over the day occurs at higher generation temperature for lower evaporator temperatures and higher condenser/absorber temperatures. A preliminary cost analysis shows that optimum annual cost ofowning, operating and maintaining the system is achieved with a generation temperature of about 80^{o}C for condenser/absorber temperature of 34^{o}C and an evaporator temperature of 3^{o}C.

oOo