DESIGN, OPTIMIZATION AND PERFORMANCE SIMULATION OF A 12 kW SINGLE EFFECT LITHIUM-BROMIDE/WATER ABSORPTION CHILLER

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ABSTRACT
This study presents the design, optimization and performance simulation of an absorption chiller of 12 kW capacity. The chiller operates with the lithium bromide/water pair. It was designed to be powered by solar energy and the design takes into consideration the availability of solar energy in a Nigerian climate. The design stage involves the formulation of mathematical equations and use of correlations from literature for the components which are mainly shell and tube heat exchangers. A program was developed in MATLAB to solve the set of nonlinear design equations. The optimization and performance simulation was done using a developed mathematical model, coded in MATLAB and formed an extension to the design program. The coefficient of performance formed the objective function for the optimization problem, in which multiple design variables were optimized for each of the heat exchanger components. The set of conditions for which performance simulation was carried out are: hot water inlet temperature ranging from 40°C to 90°C, cooling water inlet temperature ranging from 24°C to 40°C, evaporator temperature ranging from 9°C to 13°C. Results from the design calculation showed that the number of tubes required for the generator, evaporator, condenser, absorber and solution heat exchanger are: 60, 45, 55, 50 and 21 respectively. Results from the performance simulation showed a cooling power of 9.5 kW was attained with hot water temperature of 90°C and evaporator temperature of 13°C. A maximum coefficient of performance of 0.75 was attained.