Simulation of Solar-Assisted Single Stage Absorbtion Chiller as Ice Maker Based on MATLAB

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INTRODUCTION

In this research, the system is described in the two-dimensional form to simplify the completion and modeling. There are various kinds of components, among others: evaporator, condenser, Solution Heat Exchanger (SHX), absorber, generator (including solar collector), pumps, and expansion valve. There is a schema of solar-assisted single stage absorption chiller that used:

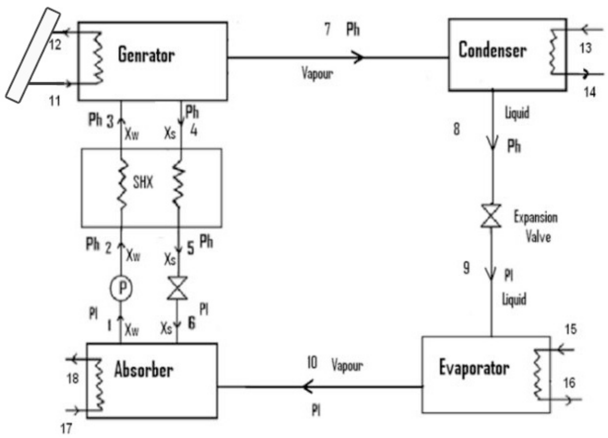

Figure 1. Schema of solar-assisted single stage absorption chiller.

Fluid from state 1 will get pressure by the pump, then passed to Solution Heat Exchanger (SHX) to get heat from the generator output (state 4). SHX Output (state 3) entering generator which will then absorb the heat from the solar collector. Generator output is divided into two parts, state 4 (going through SHX) and state 7 which will enter the condenser. Fluid on the state 8 which has been condensed and turned into a liquid phase, flows through the expansion valve to absorb heat from the state 15. Ammonia at state 10 go through to the absorber, to make the process of absorption and add to the composition of the ammonia in the ammonia-water mixture used in the first state.

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Simulation with MATLAB-based program has been conducted to determine the value of the COP system, the mass of ice that forms, and solar collector area needed by the system. Variations in the composition of the ammonia in strong solution (XS), the composition of ammonia in weak solution (XW), and the refrigerant mass flow rate ($\dot{m}_{ref}$) has performed. Variation of XS, XW, and $\dot{m}_{ref}$ cause changes in the values of property systems, such as : enthalpy, temperature and mass flow rate. Changes in the values of these peroperty cause changes in the value of the heat flow rate on the components of the system, Coefficient of Performance (COP), Solar Collector Area (ASC) needed by system, and the mass of ice produced.

In XS variation, it was found that the composition can be used is in the range 0.4 to 0.95. The variation using reference value of XW by 0.3. The range of 0.4 to 0.95 is the conclusion of the mass flow rate of data retrieval and flow rate generator heat generated from the program. Based on Figure 5, note that the value of the flow rate is negative in the range of 0.05 to 0.25, whereas the mass flow rate value XS 0.3 is infinite. This is due to factors divisor of calculation used in the program is 0, so the calculation result reaches infinite. Based on Figure 10, it is known that $\dot{Q}_g$ is negative at XS 0.35 due to changes in the value of the enthalpy at state 4 becomes -321 kJ/kg.

In XW variation, it was found that the composition can be used is in the range 0.05 to 0.3. The variation using reference value of XS by 0.4. The range of 0.05 to 0.3 is the conclusion of the mass flow rate of data retrieval and flow rate generator heat generated from the program. Based on Figure 8, note that the value of the flow rate is negative in the range of 0.45 to 0.95, whereas the mass flow rate value XS 0.4 infinite worth. This is due to factors divisor of calculation used in the program is 0, so the calculation result reaches infinity. Based on Figure 12, it is known that $\dot{Q}_g$ is negative at XS 0.35 due to changes in the value of the enthalpy at state 3 to -54.52 kJ/kg.

Changes in the mass flow rate of refrigerant in the state 7, 8, 9, and 10 resulted in changes in the rate of heat flow in the generator, condenser, absorber, and evaporator. Changes that occur have a linear pattern, the greater the value of $\dot{m}_{ref}$ increase the value of the heat flow rate on each component. COP value does not change, this is because $\dot{Q}_g$ and $\dot{Q}_e$ vary linearly. At the highest variation $\dot{m}_{ref}$, 0.02 kg/s, solar collector area needed by system reach 4.37 m2. Mass ice produced reached 470.44 kg/h. Whereas in most small variations $\dot{m}_{ref}$, 0.001 kg/s, solar collector area needed by system reach 0.22 m2. With the ASC value, mass produced ice reaches 23.52 kg/hour. Based on the data obtained, it is known that to make 1 kg of ice in 1 hour, required 0.05 kW rate of heat flow in the evaporator. Based on the data that has been taken, it is known that the maximum COP values that can be produced on a variety XS, XW, and $\dot{m}_{ref}$ amounted to 1.71. The COP values obtained with the composition of XS 0.4, 0.3 XW composition, and $\dot{m}_{ref}$ in the range of 0.001 to 0.02 kg/s.

Based on the research conducted, it is known that the greater the value $\dot{m}_{ref}$ will increase the value of the rate of heat flow in the generator, condenser, evaporator, and absorber linearly. Composition of ammonia in a strong solution (XS) that can be used is in the range 0.4 to 0.95, while the weak solution (XW) are at 0.05 to 0.3. The best COP values in this research is 1.71 with the XS 0.4 and 0.3 XW. The value of the mass flow rate of refrigerant in the state 7, 8, 9, and 10 do not affect the value of the COP.

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