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Computer Modeling of a Solar Absorption System

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Abstract

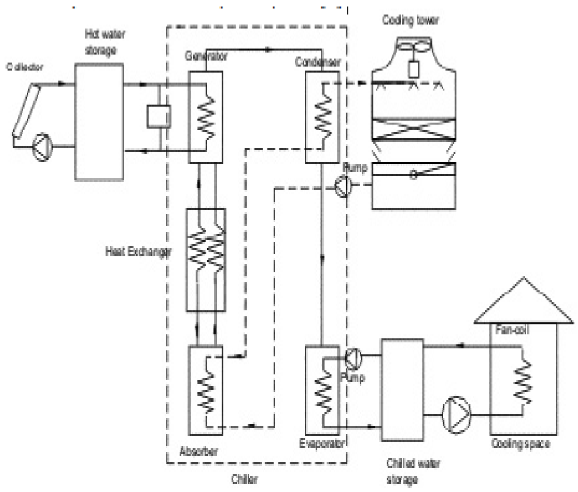
Using a solar lithium bromide absorption system, an analytical research will be conducted on the use of solar energy for space cooling. Following an overview of solar energy's value, accessibility, and potential uses, this section provides a description of a solar absorption machine [1-2]. This system's numerical simulation in Mat lab shows temperature shifts in the system's primary components, beginning with the collector, due to variations in the solar system's heat flow density. Only the collector and the unoccupied heat exchanger experience temperature fluctuations. When the solar heat flux is insufficient to meet the whole cooling demand, electricity must be used to supplement the system. The report concludes with a comparative analysis of the collector length and supplementary source requirements across the three cities studied.

1. Introduction:

One of the most abundant energy sources on is solar power. Its accessibility is conditional on variables like latitude and cloud cover. The system is expensive to implement, though. But on the plus side, solar energy is clean and the system requires nothing in the way of maintenance or operating costs. There are no unfavorable consequences on the environment. Using an absorption cycle is one way to cool using solar power. When the generator is supplied with water at temperatures between 65 and 95 degrees Celsius, a system that absorbs lithium bromide from the water works rather well. Due to the fact that flat plate solar collectors can often heat fluids up to such temperatures, there has been much study into adapting and using absorption systems for solar air conditioning.

2. Description for Solar absorption machine:

Solar energy is used to mitigate the need for conventional cooling systems. An array of high-performance flat-plate collectors powers this solar air-conditioning system, which also includes a cooling tower and an auxiliary heater [3]. When the sun isn't shining, the backup heater should kick on to keep you toasty. The boiling point difference . Between the solution of water and lithium bromide in this device causes the solution to dissociate. After being cooled, the two parts are recombined to create the cool air, which is then dispersed to the different zones in the building in the same way that traditional air conditioning would. Lithium bromide with water is a noiseless, efficient, and hygienic option. The technology is currently in its early stages of development, but it has the potential to significantly cut down on CO_2 emissions, liquid refrigerant consumption, and urban noise [5].



Schematic Representation

Figure 1 is a simplified representation of a solar absorption cooling system. Most of the past and present knowledge about solar air conditioning is based on this technique. Here, the solar energy is obtained via the collector, and is collected in the storage tank. Then, the hot water in the storage tank is given to the generator to boil off water vapor from a solution of Lithium Bromide and water. The water vapour is cooled down in the condenser and then transferred to the evaporator where it again is evaporated at low pressure, so providing cooling to the appropriate area. Meanwhile, the strong solution (solution of water and bromide of lithium rich in water) leaving the generator to the absorber passes via a heat exchanger in order to warm the weak solution (solution of water and bromide of lithium lacking in water) entering the generator. In the absorber, the strong solution absorbs the water vapour exiting the evaporator. Cooling water from the cooling tower eliminates the heat through mixing and condensation. Since the temperature of the absorber has a bigger effect on the efficiency of the system than the condensing temperature, the heat rejection (cooling water) fluid, is permitted to flow through the absorber first, and then to the condenser [4]. An auxiliary energy source is provided, so that hot water is given to the generator when solar energy is not adequate to heat the water to the appropriate temperature level needed by the generator.

3. Transient heat balance equations of the collector:

Solar heat flux and his fluctuation are directly subjected to the dynamic behavior of the collector, the glycol and rich solution heat exchanger, and the tube in tube heat exchanger. These heat exchanger systems are studied in the steady-state limitless domain. The above-mentioned heat exchanger designs share a cylindrical structure made out of a thick tube through which fluid flows. Convective heat transmission occurs between the outside of the tube and the surrounding liquid (figure 2).

For the wall: $$(\rho CS)_w \frac{\partial T_p}{\partial t} = P_e \eta_t \varphi_s - P_i h_i (T_p - T_g) + \lambda S \frac{\partial^2 T_p}{\partial x^2} \quad (1)$$

For the glycol: $$(\rho CS)_f \frac{\partial T_f}{\partial t} + (\dot{m} C)_f \frac{\partial T_f}{\partial x} = P_i h_i (T_p - T_f) \quad (2)$$

4. Transient heat balance equations of the other heat exchangers:

The glycol serves as the internal fluid and the rich solution (a lithium bromide-rich water solution) serves as the external fluid in the first heat exchanger, while the opposite is true in the second heat exchanger.

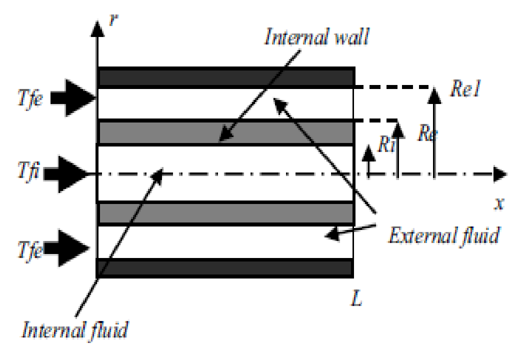


Fig.2. Physical model of the other components of the system.

For the internal fluid: $$(\rho CS)_{fi} \frac{\partial T_{fi}}{\partial t} + (\dot{m} C)_{fi} \frac{\partial T_{fi}}{\partial x} = P_i h_i (T_p - T_{fi}) \quad (3)$$

For the internal wall: $$(\rho CS)_w \frac{\partial T_p}{\partial t} = P_i h_i (T_{fi} - T_p) - P_e h_e (T_p - T_{fe}) + \lambda S_i \frac{\partial^2 T_p}{\partial x^2} \quad (4)$$

For the external fluid: $$(\rho CS)_{fe} \frac{\partial T_{fe}}{\partial t} + (\dot{m} C)_{fe} \frac{\partial T_{fe}}{\partial x} = P_e h_e (T_p - T_{fe}) \quad (5)$$

5. Solar Flux Variation in some countries and results:

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Here, we examine the relationship between the varying solar flux in three different locations (Abu Dhabi, United Arab Emirates; Lear mouth, Australia; Beirut, Lebanon) and the workload of an absorption machine. The six aforementioned equations have been simulated in Mat lab, and the results are shown in Figures 3, 4, and 5. These findings provide a clear example of the following graphs show the changes in temperature distributions along the wall, glycol, and rich solution inside the collector and the first heat exchanger on the warmest day of the year for each city. Collector length (Beirut, Lear mouth) = 240m; Collector length (Abu Dhabi) = 300m. Solar sensor efficiency = 0.8; m g = 0.05 kg/s; First heat exchanger length = 14m; m (rich solution) = 0.2kg/s. Metronome program determines the solar radiation by calculating the hourly value for solar fox on every day of the year. Each day yields 24 values.

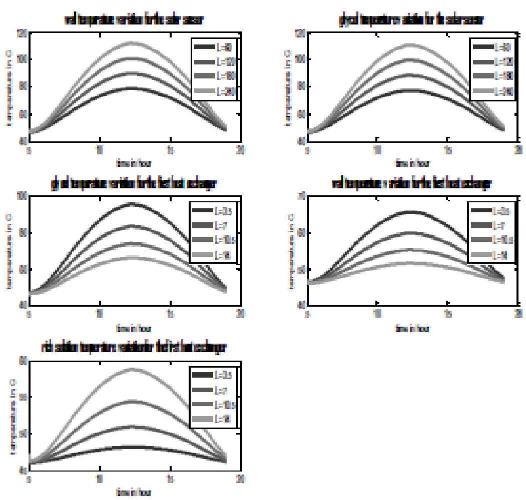

Fig. 3 Beirut (1 July)

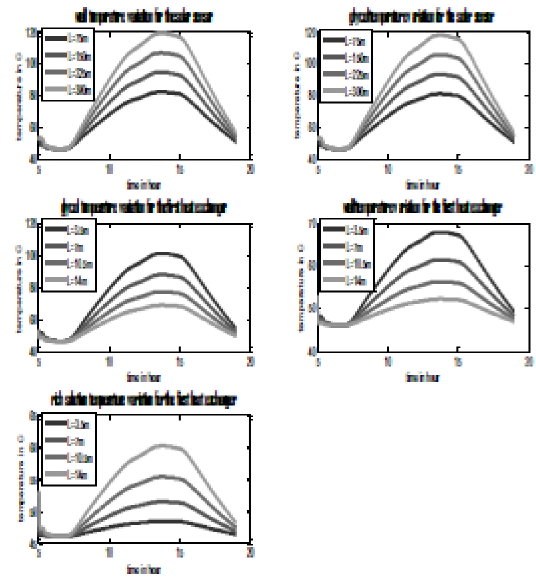

Fig. 4 Abu Dhabi (15 august)

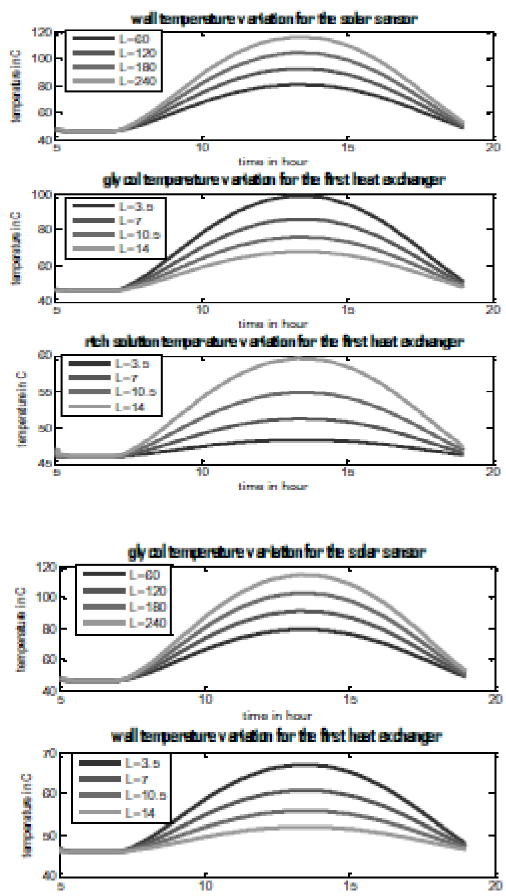

Fig.5 Lear mouth (1 March)

6. Discussion:

Maximum glycol temperature 120oC (boiling temperature) within the collection tubes is used to determine the collector length using mat lab simulation. To reduce losses, we double-glazed the collector. To reduce IR emissions, the collector's finned tubes are black chrome-plated on selected absorptive surfaces. Damages caused by radiation. Collector boiling temperature is set by the mixture ratio with water and the cap pressure. Preventing boiling with increased pressure allows for greater temperatures and more effective heat transmission. When compared to the length of the collector, the first heat exchanger is somewhat short. Exactly the same in all three of these locations. As a result, we focus only on how variations in collector length affect the temperature of the water needed by the secondary heat exchanger. Then, using the formula, we can determine the supplemental energy required:

$$\text{Auxiliary power} = \frac{\dot{m}C(Z_1 - Z)}{temps},$$

While Z is the overall surface for this graph, Z1 is the surface just below the blue curve (L=14m) depicting the temperature development of the rich solution. When we lengthen the collector, the internal temperature of the glycol rises above that of the incoming water. Generator ramps up, reducing the need for supplementary power. For the absorption cycle to function correctly and for the required comfort level to be achieved, the rich solution entering the generator should be kept at a temperature of 83 oC. A small house's cooling load may be estimated differently in one city than in another, and even on different days. For these calculations, we utilize a program called Elite CHVAC. See below for a graph depicting the absorption machine's guaranteed power (green curve), the air conditioning load (blue curve), and the auxiliary power (red curve):

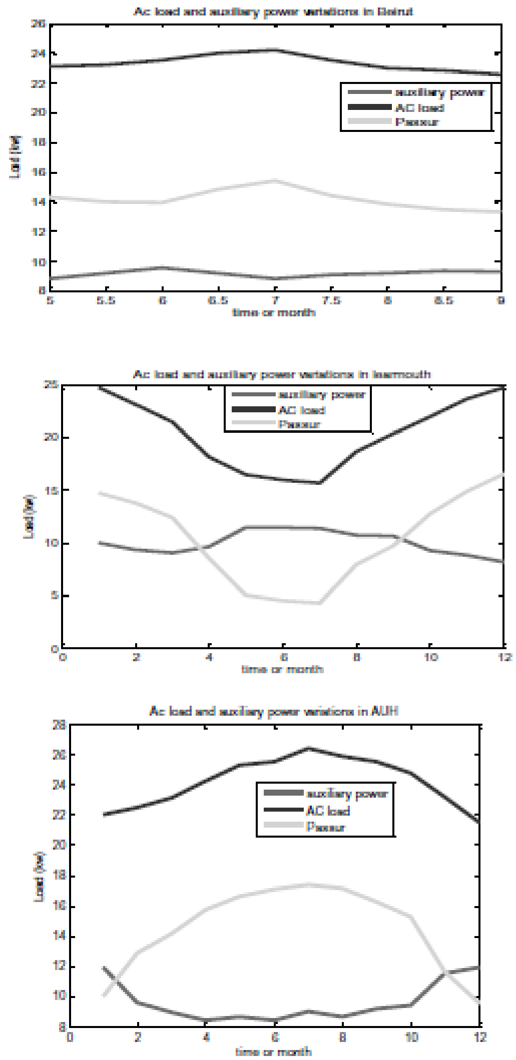

Fig.6 Auxiliary Power in Beirut, Abu Dhabi, Lear mouth

7. Conclusion

In this paper, we describe a numerical simulation of a solar absorption machine in three cities with daily varying solar flux. This simulation displays the temperature shift throughout the machine and calculates the longest possible collector length for each city. Take the collector length as an example: Glycol within will evaporate once the height exceeds 240 meters in Beirut. The heat exchangers of a solar absorption machine have their diameter, material, and convection coefficient adjusted. The temperature of the rich solution is the most crucial factor in determining how much backup power will be required to provide the required level of convenience. The goal is to expand the research to include solar flux in more urban centers.

References

[1] F.Meunier, Solid sorption heat powered cycles for cooling and heat pumping applications, Applied Thermal Engineering 18 ,1998

[2] G.Cacciola, G. Restuccia, Progress on absorption heat pumps, Heat Recovery Systems & CHP 14(4), 1994.

[3] Meza J.I, A.Y. Khan, and J.E. Gonzalez, Experimental assessment of a solar-assisted air conditioning system for applications in the Caribbean, New mexico, 1998.

[4] Li ZF & Sumathy K. , Technology development in the solar absorption air conditioning systems, Renewable and sustainable energy Reviews, vol(4),2000.

[5] ALEFELD & al: Advanced absorption cycles and systems for environmental protection, Japan, 1991.