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The Use of Solar Energy for Cold Production

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Abstract : —It is imperative today to further explore alternatives to fossil fuels by promoting in particular renewable sources such as solar energy to produce cold. It is also important to carefully examine its current state as well as its future prospects in order to identify the best conditions to support its optimal development. Technologies linked to this alternative source fascinate their users because they seem magical in their ability to directly transform solar energy into cooling without resorting to polluting fuels such as those derived from hydrocarbons or other toxic substances. In addition, these not only allow significant savings in electricity, but can also help reduce the costs of electrical energy production when applied on a large scale. In this context, our study aims to analyze the performance of solar adsorption cooling systems by selecting the appropriate pair Adsorbent/Adsorbat. This paper presents a model describing the heat and mass transfer in tubular finned adsorber of solar adsorption refrigerating machine. The modelisation of the solar reactor take into account the heat and mass transfers phenomena. The reactor pressure is assumed to be uniform, the reactive reactor is characterized by an equivalent thermal conductivity and assumed to be at chemical and thermodynamic equilibrium. The numerical model is controlled by heat, mass and sorption equilibrium equations. Under the action of solar radiation, the mixture of adsorbent–adsorbate has a transitory behavior. Effect of key parameters on the adsorbed quantity and on the thermal and solar performances are analyzed and discussed. The results show that, The performances of the system that depends on the incident global irradiance during a whole day depends on the weather conditions. For the used working pairs, the increase of the fins number corresponds to the decreasing of the heat losses towards environmental and the increasing of heat transfer inside the adsorber. The system performances are sensitive to the evaporator and condenser temperatures. For the considered data measured for clear type days of may and july 2023 in Algeria and Tunisia, the performances of the cooling system are very significant in Algeria compared to Tunisia.

Keywords : adsorption, adsorbent-adsorbate pair, finned reactor, numerical modeling, solar energy
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