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Thermal Performance of an Air Heating Storing System

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Abstract : Owing to the lack of synchronization between the solar energy availability and the heat demands in a specific application, the energy storing sub-system is necessary to maintain the continuity of thermal process. The present work is dealing with an active solar heating storing system in which an air solar collector is connected to storing unit where this energy is distributed and provided to the heated space in a controlled manner. The solar collector is a box type absorber where the air flows between a number of vanes attached between the collector absorber and the bottom plate. This design can improve the efficiency due to increasing the heat transfer area exposed to the flowing air, as well as the heat conduction through the metal vanes from the top absorbing surface. The storing unit is a packed bed type where the air is coming from the air collector and circulated through the bed in order to add/remove the energy through the charging / discharging processes, respectively. The major advantage of the packed bed storage is its high degree of thermal stratification. Numerical solution of the packed bed energy storage is considered through dividing the bed into a number of equal segments for the bed particles and solved the energy equation for each segment depending on the neighbor ones. The studied design and performance parameters in the developed simulation model including, particle size, void fraction, etc. The final results showed that the collector efficiency was fluctuated between 55%-61% in winter season (January) under the climatic conditions of Misurata in Libya. Maximum temperature of 52ºC is attained at the top of the bed while the lower one is 25ºC at the end of the charging process of hot air into the bed. This distribution can satisfy the required load for the most house heating in Libya.

Keywords : solar energy, thermal process, performance, collector, packed bed, numerical analysis, simulation
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