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Theoretical and Experimental Investigation of Heat Pipes for Solar Collector Applications

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Abstract : Heat pipes are efficient heat transfer devices for solar hot water heating systems. However, the effective downward transfer of solar energy in an integrated heat pipe system provides increased design and implementation options. There is a lack of literature about flat plate wicked assisted heat pipe solar collector, especially with the presence of finned water-cooled condenser wicked heat pipes for solar energy applications. In this paper, the consequence of incorporating fins arrays into the condenser region of screen mesh heat pipe solar collector is investigated. An experimental model and a transient theoretical model are conducted to compare the performances of the solar heating system at a different period of the year. A good agreement is shown between the model and the experiment. Two working fluids are investigated (water and methanol) and results reveal that water slightly outperforms methanol with a collector instantaneous efficiency of nearly 60%. That modest improvement is achieved by adding fins to the condenser region of the heat pipes. Results show that the collector efficiency increase as the number of fins increases (upon certain number) and reveal that the mesh number is an important factor which affect the overall collector efficiency. An optimal heat pipe mesh number of 100 meshes/in. With two layers appears to be favorable in such collectors for their design and operating conditions.

Keywords : heat pipe, solar collector, capillary limit, mesh number
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