The Effect of the Volume Flow rate on the Efficiency of a Solar Collector

The flow distribution inside a collector panel with an area of 12.5 m² and with 16 parallel connected horizontal fins and the effect of the flow nonuniformity on the risk of boiling and on the collector efficiency have been theoretically and experimentally investigated for different volume flow rates. Theoretically, a simplified model of the solar collector panel is built by means of the CFD (Computational Fluid Dynamics) code Fluent, where the geometry of the collector panel except the casing is fully modeled. Both lateral and longitudinal heat conduction in the absorber fins, the heat transfer from the absorber to the solar collector fluid and the heat loss from the absorber are considered. Flow and temperature distribution in the collector panel are investigated with buoyancy effect. Measurements are carried out with the solar collector panel. Collector efficiencies are measured for different flow rates, temperature levels and solar irradiances. The measured efficiencies are compared to the results of the CFD calculations. There is a good agreement between the measured and calculated results. Further, calculations with the CFD model elucidate the flow and temperature distribution in the collector. The collector efficiencies are calculated by means of CFD calculations and efficiency expressions are determined based on the results of the calculations. The influence of flow nonuniformity on the efficiencies of the solar collector is elucidated for different volume flow rates and weather conditions.

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