Evaluation of Thermal Performances of a Novel Polymer Solar Collector Design

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Abstract
Experimental and numerical evaluation of the thermal properties of an unique prototype polymer solar collector are reported in this work. The experimental part incorporates an alternative method for determining the optical properties of polymer materials and thermal efficiency measurements. Thermal efficiency functional dependence on solar radiation, working fluid, and air temperature is computed. In order to validate the numerical model developed in the ANSYS FLUENT software suite, simulations are performed on a segment of the polymer solar collector, and the results are correlated with experimental data. The efficiency curve coefficients (h0, a1 and a2) are then derived for an eight-segment collector. During the normal summer operation regime, the obtained efficiency of the proposed polymer collector design is up to 20 percent lower than that of the state-of-the-art flat plate collector (FPC). A parametric numerical analysis of a polymer solar collector is per formed to evaluate the impact of design and operating parameters on thermal performance and to provide guidelines for design optimization. In addition, stagnation temperature measurements are performed in line with EN ISO 9806 : 2017 when a stagnation temperature of 125,1°C is recorded after the implementation of overheating safety measures.