Abstract

As a new experimental work that was not considered before in the photovoltaic system field, the thermal and electrical performance of a single-pass hybrid (Photovoltaic/Thermal) collector is investigated under the effect of an oscillatory (unsteady) air flow. The pulsating flow with a unidirectional component that fluctuates about a mean value is considered as an alternative to the steady flow in cooling the hybrid (Photovoltaic/Thermal) collector. The system consists of two solar panels connected in parallel with two fans to provide an oscillating flow through a rectangular wooden duct. A new electrical and mechanical pulsating flow system is manufactured to generate and supply the fans with a sine wave voltage signal under various operating frequencies.

The current experimental work was compared with previous researches to validate the results using steady flow and found good agreement with researches. Also, the angle of inclination of the hybrid collector was examined in the range of (20°-50°). It is found that the optimum angle for the hybrid collector is approximately 30° in the environment of AL-Fallujah city. Also under steady flow, the thermal and electrical properties of the collector were examined for air flow rates varying from 0.04 kg/s to 0.163 kg/s and Reynolds number (6926-28560). It is found that the electrical efficiency depends on the amount of incident solar radiation, whereas the air flow rate has no significant effect on the electrical efficiency, but it is important to cool the solar panels to increase their service life. The maximum electrical efficiency of the loads reached (4.88%) at a flow of (0.135 kg/s), and it was also found that the maximum thermal efficiency is 33.53% at a flow rate of 0.163 kg/s.

Under the limitation in the range of oscillating frequencies resulting from the limitations of the experiments, the pulsating flow was fluctuated at

frequencies (0.2 Hz, 0.4 Hz, 0.6 Hz, 0.8 Hz, 1 Hz, 2 Hz) with a unidirectional mean velocity of 2.2 m/s. The oscillating velocity was monitored and recorded as a function of the generated and supplied voltage to the two fans by an oscilloscope. It was found that under this range of frequencies (0.2-2 Hz), there is no significant contribution of the pulsating flow to the thermal and electrical efficiencies compared to steady flow.