**Chapter 2.15 - Comparative Study of Active and Passive Cooling Techniques for Concentrated Photovoltaic Systems**

**Abstract**

This chapter compares active and passive cooling techniques for a concentrated photovoltaic system (CPV). In the active technique, a wide microchannel heat sink (WMCHS) and manifold microchannel heat sink (MMCHS) are used to achieve better thermal management of the CPV system. In the passive technique, the integration of phase change materials (PCMs) and the insertion of metal fins are studied. A comprehensive two-dimensional model was developed to determine the performance of the CPV–thermal systems. The model was numerically simulated and validated using various sets of previous experimental and numerical results. Based on the simulation results, it was found that the MMCHS achieved better solar cell temperature uniformity with lower friction power compared with the WMCHS. At a concentration ratio (CR) of 15 and 20, it is recommended to use a WMCHS with minimum coolant mass flow rates of 60 and 350 g/min, respectively. In addition, CPV systems can safely operate when it they are combined with MMCHS with minimum coolant flow rates of 120 and 550 g/min at CR = 15 and 20, respectively. In the case of the passive cooling technique at CR = 5, the incorporation of fins significantly reduces the cell temperature from an average of 72°C without fins to around 58°C with four fins. In addition, at CR = 10, the solar cell temperature uniformity of the nonfinned CPV-PCM system equals 13.5°C. Although the microchannel heat sink (MCHS) consumes a portion of the CPV's electrical power, the electrical efficiency and the net gained power for the systems with the PCM were smaller than by using the MCHS. At CR = 20, the net gained electric power for the investigated cell area of 12.5 × 12.5 cm2 was 39.6, 41.1, 20.3, and 29.7 W using WMCHS, MMCHS, PCM and two fins, and PCM and four fins, respectively.