

Study of Hybrid Photovoltaic Thermal (HPVT) Solar Water Heater at Constant Collection Temperature for Indian Climatic Conditions

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Abstract

In this communication, two different cases, case A (collectors partially covered by PV modules; 30% PV) and case B (collectors fully covered by PV modules), connected in series have been considered for the study. The analysis has been based on the thermal energy, exergy, and electrical energy analysis. The whole study has been done by considering four weather conditions (a, b, c, and d types) for five different cities (New Delhi, Jodhpur, Bangalore, Mumbai, and Srinagar) of India. Comparison of conventional flatplate collectors (FPC) with case A and case B has also been done for New Delhi weather conditions. Based on numerical calculations, it has been found that the total annual gain is maximum for the Jodhpur city and minimum for the Srinagar. The percentage variation between Jodhpur and Srinagar city is 25% and 23.4% for case A and case B, respectively. The annual gain for New Delhi, Mumbai, and Bangalore is nearly the same. The percentage variation between these three cities and Srinagar is 12%, 15.2%, and 10.4% for case A and 10.2%, 14%, and 9.3% for case B, respectively. At the beginning, Wolf has done the work on a flatplate PV/T-liquid collector. He has analyzed a silicon solar array mounted inside a stationary non-concentrating

thermal collector using a lead-acid battery as the storage element for residential heating and concluded that the system was technically feasible and cost effective. Kern and Russell have reported the main concepts of these systems with results by the use of water or air as a heat removal fluid. Hendrie has presented a theoretical model on PV/T systems using conventional thermal collector techniques. Florschuetz has suggested an extension

Kalogirou has calculated the yield of a 4 m² PV/T thermosyphon system for different climates. Zondag has carried out a rigorous review on research work of PV-thermal collectors and systems, carried out by various scientists till 2006. His review includes the history and importance of a photovoltaic hybrid system and its applications in various sectors. Energy and exergy analysis of photovoltaic thermal collector with and without glass cover has been studied by Chow et al. They concluded that the increase of on-site solar radiation or ambient temperature has been seen as the favorable factor for selecting a glazed PV/T system. Chow has carried out a review work on the research work of hybrid PVT technology. He recommended carrying out the work regarding thermal absorber design and fabrication, material and selective coating, energy conversion and effectiveness, performance testing, system optimization, control, and reliability. Hybrid PVT is expected to have a significant market expansion potential in the near future. Norton et al. Have given the solution to enhance the performance of building integrated photovoltaic systems. Recently, Tiwari et al.