

Experimental Investigation on Performance of Solar-Powered Attic Ventilation

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Abstract:

An attic ventilation system has the potential to reduce cooling load and power consumption of an air-conditioning system in buildings that experience elevated temperature in the attic space during the day. For this, a solar-powered attic ventilation system, which harnesses the abundant source of solar energy from the sun, is desired to ventilate the hot attic space in an economical way. On the other hand, it is known that the efficiency of photovoltaic (PV) cells decreases when temperature of the solar panel increases. This chapter discusses the design and development of an efficient and low-cost solar-powered attic ventilation system. The novelty approach is intended to improve the PV efficiency and the overall performance of the system by providing airflow for the solar panel from outflow of the ventilation system. The designed and developed solar-powered attic ventilation system consists of an exhaust fan powered by a polycrystalline solar panel, a direct current to direct current (DC-DC) step-down converter power module, ducting system, and ventilation casing assembled together. Components like ventilation casing and angle adjustable mounting for solar panel are prepared through fabrication work. A few experiments and testing on ventilation process and PV efficiency are conducted to determine the performance, working condition, and functionality of the developed system. Parameters like ambient temperature and indoor temperature of the research location are studied in the experiment of ventilation process. Solar irradiance, the power produced from the PV, and the power delivered to the exhaust fan are studied through the experiment on PV efficiency. The developed solar-powered attic ventilation system reduces the attic temperature by 2.9 °C and keeps the temperature difference between the ambient and indoor in the range of 0.1–0.4 °C. An increment of about 17% was observed for the PV efficiency when there is airflow for the PV module from outflow of the ventilation system.

Keywords: Solar - Powered; Cost Solar; Air-Conditioning System