




Active cooling system for efficiency improvement of PV panel and utilization of waste-recovered heat for hygienic drying of onion flakes

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ABSTRACT

In the modern age, photovoltaic panel (PV) is a popular option for solar energy conversion. The PV panel's efficiency considerably depends on the parameters like dust or dirt on the surface and the cell operating temperature. As the cells operating temperature exceeds more than 25 °C, the PV panel's efficiency decreases by 0.4% for every degree centigrade rise in temperature. The higher cell operating temperature causes hot spots on the PV panel, drastically reducing the PV panel's life. There are different methods used for cooling of PV panel, but the utilization of waste heat recovered for further application is not reported. In this context, this research work proposes an active cooling system using thermal grease and M.S chips for effective cooling of the PV panel, and simultaneously heat rejected during cooling of the panel is being used for solar thermal drying. The proposed active cooling system using thermal grease and M.S chips showed promising results at 5.2 m/s air velocity. The average voltage and average electrical efficiency of the cooled PV panel was improved by ~ 4.0% and 12.3%, respectively, than the non-cooled PV panel. The cooled PV panel's cell operating temperature was reduced by 16.1 °C compared to non-cooled PV panel, and 1400 g onion flakes were dried hygienically in time 10 h 30 min.

Nomenclature

PV Photovoltaic
STC Standard testing condition
TWh Terawatt-hour

m_a Mass flow rate of air (kg/s)
 v Velocity of air (m/s)
 σ Density of air (kg/m³)
 w Width of duct (m)
 h Height of duct (m)
 m Parametric constant (m⁻¹)

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