Performance Evaluation of Solar Water Heater Integrated Photovoltaic Panel

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Abstract

Hybrid PV/T water heating system uses solar energy to produce electricity and thermal energy simultaneously. Photovoltaic panel uses solar light energy to produce electricity and flat plate collector uses solar heat energy to produce hot water. The water first spray over the top surface of the PV panel and then goes to the collector inlet and being hot get out from the collector outlet and store in the storage tank. The water is supplied at a rate of .56 L/min, 1.56 L/min, 2.56 L/min, and 3.56 L/min, respectively. The highest efficiency of the panel is obtained at 45° tilt angle. Also, with the increase of mass flow rate the outlet temperature of the collector decreases. The highest thermal efficiency of the collector is 68.3% and the highest hot water from collector is 84.6°C. Moreover, the experimental results show, for mass flow rate 1.56 L/min a maximal total increase of 16.78% (effective 4.19%) in PV panel electrical efficiency is achieved by using the proposed cooling technique in the circumstance of peak solar irradiation. Furthermore, the reduction of panel temperature is ranged from an average 45.08°C to 34.12°C. Also, the performance of PV panel is affected by dust. Spray technique is a self-cleaning system which removes the dust from top surface of the PV panel and the efficiency is significantly increased by 2.53 %. However, the mass loss of the system is only due to the evaporation of water and mass loss due to leakage is negligible because all the possible and visible leakages are sealed properly.

Image

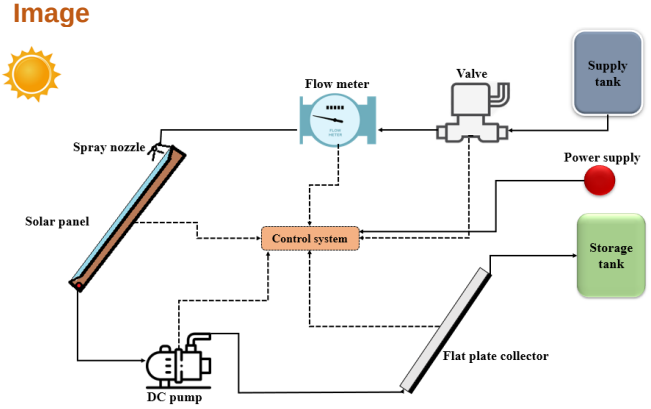


Figure 1. System configuration layout

Recent Publications

1. Arefin, M. A., Islam, M. T., Zunaed, M., & Mostakim, K. (2020). Performance analysis of a novel integrated photovoltaic–thermal system by top-surface forced circulation of water. Clean Energy, 4(4), 316-327.
2. Gulagi, A., Ram, M., Solomon, A. A., Khan, M., & Breyer, C. (2020). Current energy policies and possible transition scenarios adopting renewable energy: A case study for Bangladesh. Renewable Energy, 155, 899-920.
3. Hasanuzzaman, M., Malek, A. B. M. A., Islam, M. M., Pandey, A. K., & Rahim, N. A. (2016). Global advancement of cooling technologies for PV systems: A review. Solar Energy, 137, 25-45.
4. Sullivan EV, Rahman, M. M., Hasanuzzaman, M., & Rahim, N. A. (2015). Effects of various parameters on PV-module power and efficiency. Energy Conversion and Management, 103, 348-358.
5. Long, H., Chow, T. T., & Ji, J. (2017). Building-integrated heat pipe photovoltaic/thermal system for use in Hong Kong. Solar Energy, 155, 1084-1091.



Biography

Khodadad Mostakim is currently studying at Rajshahi University of Engineering & Technology, Bangladesh. His research Interests include Diesel engine and Micro gas turbine system, electric and hybrid vehicle, and Renewable energy systems. Recently, his book chapter is published on **Springer** – Intitled "**Greener and Scalable E-fuels for Decarbonization of Transport**". His upcoming book chapter is about '**Solar Thermal Energy**'. Currently, he is working on a Hybrid PV/T sand Waste management system project.

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