

Performance analysis of a novel integrated photovoltaic–thermal system by top-surface forced circulation of water

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Almost 80–90% of energy is wasted as heat (provides no value) in a photovoltaic (PV) panel. An integrated photovoltaic–thermal (PVT) system can utilize this energy and produce electricity simultaneously. In this research, through energy and exergy analysis, a novel design and methodology of a PVT system are studied and validated. Unlike the common methods, here the collector is located outside the PV panel and connected with pipes. Water passes over the top of the panel and then is forced to the collector by a pump. The effects of different water-mass flow rates on the PV panel and collector, individual and overall efficiency, mass loss, exergetic efficiency are examined experimentally. Results show that the overall efficiency of the system is around five times higher than the individual PV-panel efficiency. The forced circulation of water dropped the panel temperature and increased the panel efficiency by 0.8–1% and exergy by 0.6–1%, where the overall energy efficiency was ~81%. Bangladesh is confronting a great deal of energy emergencies and genuine desertification issues in provincial areas. These issues could be ameliorated if sustainable power sources are utilized as an essential source of energy in rural regions. Although Bangladesh has a considerable amount of fossil resources, the amount is degrading to a great extent as the dependency on it is remarkable. For instance, the primary sources of energy in this country are natural gas (60%) followed by hydropower and coal, which are probably going to be exhausted very soon due to their extensive use [1]. Therefore, if no advanced innovation is introduced, then Bangladesh will face a tremendous energy crisis in the future. In these cases, sustainable power sources are the only hope for the general population of Bangladesh. Individuals have an expansive unsatisfied need for energy that is developing by 10% yearly [2, 3]. In the last few years, the government has taken several initiatives to address the energy crisis. Not only in the public sectors, but also this issue is given much importance from different individual sectors. Although power generation in the most recent years has increased a lot, still it is not enough to face the soaring demand of the country. Moreover, Bangladesh has the lowest per capita consumption of energy in South Asia [3]. Presently, the total generation capacity is 15 821 MW [1, 4]. Coal, gas and diesel are being used in Bangladesh for producing electricity as primary resources. At present, there is a huge gap between production and demand. The demand is increasing day by day and there is a prediction that it will reach ~40 000 MW by the year 2030 [5].