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# Numerical Modeling of hybrid Photovoltaic-Thermoelectric Solar Unit by Applying Various Cross-Sections of Cooling Ducts

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**Abstract :** Combining the photovoltaic/thermal (PVT) systems with a thermoelectric (TE) module can raise energy yields since the TE module boosts the system's energy conversion efficiency. In the current study, a PVT system integrated with a TE module was designed and simulated in ANSYS Fluent 19.2. A copper heat transfer tube (HTT) was employed for cooling the photovoltaic (PV) cells. Four different shapes of HTT cross-section, i.e., circular, square, elliptical, and triangular, with equal cross-section areas were investigated. Also, the influence of Cu-Al2O3/water hybrid nanofluid (0.024% volume concentration), fluid inlet velocity ($u_i$ ), and amount of solar radiation (G), on the PV temperature ($T_{pv}$) and system performance were investigated. The ambient temperature ($T_a$), wind speed (u□), and fluid inlet temperature ($T_i$), were considered to be 25°C, 1 m/s, and 27°C, respectively. According to the obtained data, the triangular case had the greatest impact on reducing the compared to other cases. In the triangular case, examination of the effect of hybrid nanofluid showed that the use of hybrid nanofluid at 800 W/m2 led to a reduction of the TPV by 0.6% compared to water, at 0.19 m/s. Moreover, the thermal efficiency ( ) and the overall electrical efficiency ($n_t$) of the system improved by 0.93% and 0.22%, respectively, at 0.19 m/s. In a triangular case where G and were 800 W/m2 and 19 m/s, respectively, the highest amount of, thermal power ($E_t$), and, were obtained as 72.76%, 130.84 W and 12.03%, respectively.

**Keywords :** electrical performance, photovoltaic/thermal, thermoelectric, hybrid nanofluid, thermal efficiency
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