Heat Transfer Performance of a Novel Circular Flow Jet Impingement Bifacial Photovoltaic Thermal PVT Solar Collector

ABSTRACT

Jet impingement is commonly used to enhance the performance of solar collectors by improving the heat transfer rate. This paper presents a Novel Circular Flow Jet Impingement applied to a bifacial photovoltaic thermal (PVT) solar collector. The energy performance of the PVT solar collector was analyzed using CFD COMSOL simulation. The circular flow cup was attached to the jet plate with 36 jet plate holes and streamwise pitch, X = 113.4mm, and spanwise pitch, Y= 126mm. The inlet circular cup diameter of 6mm and outlet jet plate hole of 3mm are used to promote impinging jet effects on the photovoltaic module. The mass flow rate ranges between 0.01-0.14kg/s, and Reynolds number ranges between 2,738-14,170 to promote turbulent flow. The swirling and diffusive properties of turbulence enhance the heat transfer rate. The study was conducted to analyze two distinct scenarios: the first sought to identify the optimal diameter size, and the second sought to determine the optimal depth for the circular cup. Each model was tested with a solar irradiance ranging from 600W/m2 to 900W/m2 . The optimum design for the Circular Flow Jet Impingement was achieved using a 40mm diameter and 20mm depth with a maximum photovoltaic, thermal, and overall efficiency of 63%, 11.09% and 74.09% at an irradiance of 900W/m2 and flow rate of 0.14kg/s.