Sustainable potable water production using a solar still with photovoltaic modules-AC heater

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\begin{abstract}
Solar energy as a sustainable energy source can be harnessed to produce potable water using solar stills. In this work, effort was made to evaluate the performance of a double slope solar still integrated with a 500 W heater to produce potable water. The heater was powered by six photovoltaic modules, which can produce 1.5 KWp and then connected to four batteries with capacity of 150 Ah each. The experiments were conducted over several days in the tropical climate of Malaysia. A black painted steel trough with length 90 cm, width 45 cm, and depth 8 cm was used as the basin of the glass covered double slope solar still. A comparison of the cumulative water production between the conventional solar still (CSS) and solar still with PV-Heater (CSSPVH) was done. The CSSPVH was found to be more effective; producing about six times the amount of water produced by the CSS. Mathematical models derived based on energy balance studies of CSSPVH, were used to carry out simulations to verify the experimental findings. The energy balance equations of condensing cover and the basin water of CSSPVH were developed as well. A good agreement was found between numerical and experimental productivities of CSSPVH. An expected increase in water production of up to 16 kg/m\textsuperscript{2} per 24 h was obtained using CSSPVH. Therefore, CSSPVH is an effective design to produce sustainable potable water, even in areas with very low daily solar radiation intensity, due to its ability to store solar energy. In addition, some tested water quality parameters indicate that water produced from solar stills meet the WHO standard for potable water.

\textbf{Keywords:} Solar energy; Heat and mass transfer; Photovoltaic module; Solar still; Water heater
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