A mathematical model of single basin solar still with an external reflector

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ABSTRACT

A transient mathematical model was presented for a single basin solar still with and without an external reflector. The model was based on an analytical solution of the energy balance equations for various elements of the still. The performance of the still with and without the external mirror was investigated by computer simulation using the climatic conditions of Jeddah (lat. 21° 42′ N, long. 39° 11′ E), Saudi Arabia. Effects of solar radiation intensity and mass of basin water on the daily productivity P_d and efficiency η_d of the still were studied. On typical summer (17/7/06) and winter (17/1/06) d, values of P_d of 10.563 and 6.650 (kg/m²d) with daily efficiencies of 56.78 and 52.04% were obtained with mirror compared to 4.605 and 2.260 (kg/m²d) with daily efficiencies of 50.69 and 44.76% when the still is used without mirror. To validate the proposed mathematical model, the simulated results were compared with the measurements that had been performed for the still under Tanta, lat. 30° 47′ N (Egypt), weather conditions. It was found that the proposed model is able to predict the daily productivity and efficiency of the still with a reasonable accuracy. Furthermore, the proposed model was used to predict the annual performance of the still with and without mirror. The annual average of P_d with mirror is found to be 52.75% higher than that when the still is used without mirror.

Keywords: Solar stills; Single basin; External reflector; Productivity

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