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Theoretical study of water desalination by a falling film solar unit

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ABSTRACT

The productivity of a solar desalination unit with falling film is theoretically investigated. The theory is based on unsteady state energy balance of the three components forming the solar unit, namely the solar collecting surface (black plate), glass cover and the water film. The resulting sets of equations were integrated numerically by Runga–Kutta 4th order method using MATLAB. The effect of feed water flow rate, solar irradiation to mimic various seasons of the year, ambient temperature, plate temperature, glass cover temperature and feed water temperature on the productivity of the unit were investigated. The results showed that the unit productivity can be improved by decreasing the feed water flow rate and the glass cover temperature and by increasing the irradiation intensity, black plate temperature and the feed water temperature. The ambient temperature has an insignificant effect on the unit productivity. A linear relationship was found to exist between the amount of water produced and time. To investigate the effect of receiving the maximum irradiation during the day time, the equations were solved by taking the irradiation energy constant at its maximum value. Doing so, the amount of water produced increased by 27%. The theoretical results were compared to published experimental data, the agreement is excellent.

Keywords: Desalination; Solar irradiation; Falling film; Water; Solar collector

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