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Experimental investigation of a solar desalination with humidification-dehumidification using a rotating surface

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ABSTRACT

Water desalination by humidification-dehumidification (HDH) process powered by solar energy is a promising technique for small capacity production plants. This process has several advantages such as the use of separate components for the thermal processes (evaporation and condensation), allowing each component to be independently designed and allowing more flexibility in the design of the thermodynamic cycle. This use of a rotating black surface in an enclosed solar desalination unit to form a thin tab water film exposed to sun rays was investigated. Formation of thin film leads to rapid evaporation. A moving belt passing through water body was used for this purpose. External condenser was used to preheat the feed water and to improve fresh water productivity. The working principle of the setup was based on semi-closed water open-air flow. The effect of various parameters including the cooling water flow rate in the dehumidifier, the volumetric flow rate of air entering the unit, the rotating surface speed, and the weather conditions on the unit productivity was investigated. The average productivity obtained is 9 L/m^2·day during the hot months using cooling water at flow rate of 0.035 kg/s, air at volumetric flow rate of 30 m^3/hr and motor speed at 10 rpm. The results show that increasing cooling water flow rate and volumetric flow rate of air while slowing the moving surface speed increased the unit productivity.

Keywords: Desalination; Solar radiation; HDH process; Rotating surface; External condenser

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