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Solar desalination system integrated to use waste heat of air conditioners for continuous output: suitable for coastal areas

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ABSTRACT

In this work, a solar desalination system working through cyclic humidification and dehumidification and also utilizing waste hot air of air conditioner is analyzed numerically for the production of potable water during day and night both operations. The productivity of the proposed system is investigated for different operating and design variables and compared with a conventional system by simulation of a mathematical model based on energy and mass conservation of considered components in transient behavior using MATLAB. During simulations, climatic and geographic condition of Mumbai (India) is used due to the availability of saline water, humid air and the high annual operation of air conditioners. In proposed system air is heated by a double pass solar air heater whereas the saline water is heated by the hot air coming out from the air-cooled condenser of air conditioning unit particularly during day hour operation. The same arrangement is used to heat both air and water during night hours. The use of hot air from the condenser of air conditioner proved beneficial by increasing the yield by 21%–31% per day that depends under different operating and design conditions. Air mass flow rate of 0.032–0.035 kg/s in air heater found suitable and resulted in maximum productivity of 6 kg/d. The mass flow rate of cooling water at 0.038 kg/s has been found suitable with a maximum productivity of 7 kg/d. Need for higher Initial water temperature in a storage tank with a productivity of 8.2 kg/d at water temperature 46°C and low temperature of cooling water in a dehumidifier with a maximum productivity of 10 kg/d found by the analysis. Productivity variation in the range 4–10.2 kg/d has been found as the heater area varied from 0.5 to 2.5 m^2. The proposed system found suitable to work in a region with higher wind speed and ensured better utilization of thermal energy with gained output ratio close to 1.

Keywords: Desalination; Humidification; Dehumidification; Solar energy; Heat transfer

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