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Comparative analysis on the proposed novel absorber configuration in a solar still

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ABSTRACT

Two solar stills were investigated by different absorbers under the same operating condition. A conventional flat basin absorber where the water is a single pool in a basin area of 0.5 m² and a modified solar still with a chess board type absorber (CBTA) are investigated. CBTA has divided compartments in which water fills alternatively in the boxes of an area of 0.02 m² each. This research mainly focuses on the increasing solar still's evaporation rate by CBTA at varying water depths of 2.5, 5, and 7.5 cm, respectively. Maximum productivity was obtained for the modified solar still with the proposed CBTA compared with the conventional basin absorber for all the variations in the depth of water maintained in both cases. The modified SS yields 3,086 mL/d of water for an absorber area of 0.5 m², whereas the conventional still yields 2,456 mL/d for a depth of 2.5 cm. The thermal efficiency of modified and traditional SS is 42.75% and 24.63%, respectively. The future scope of this CBTA can be varying the shapes of the absorbers like triangular, cylindrical, conical, star pattern, rhombic, and other possible forms. The limitation of the proposed system is that filling the water in the absorber is the major problem incurred.

Keywords: Chess board type absorber; Water depth; Evaporative heat transfer; Thermal efficiency; Water yield

1. Introduction

The desalination process using solar still is environmentally friendly, as it does not consume any electricity for its operation. The use of solar stills can be dated back to ancient civilizations. Based on the evolution of technology, various modifications in solar stills, from energy storage and reflectors to augmenting the absorber with solar collectors, solar ponds, waste heat recovery units, or internal changes such as fins, wick materials, etc.

Panchal et al. [1] performed the experimental analysis on a single basin solar still with the insertion of porous fins on the absorber plate; the distillate output of the solar still with fins had a 3.8-L rise than the conventional solar still, which had a 2.67-L yield. An overall increment in the efficiency of 42.3% using porous fins in the solar still. Sathish et al. [2] studied the modified solar still in which metal matrix structures acted as a sensible heat storage material and observed some improvements in the yield. Kabeel and Abdelgaied [3] experimented with a solar still with multi-groups of two coaxial pipes in the basin. The modified solar still with multi-groups of two coaxial tubes in the basin enhanced the distillate water productivity by 97.8%, 77.4%, 63.6%, and 52.7%.

Panchal et al. [4] tried different energy storage materials marble pieces and sandstones. The sandstone energy

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