



# Productivity enhancement of hemispherical solar still using $\text{Al}_2\text{O}_3$ -water-based nanofluid and cooling the glass cover

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## Abstract

The hemispherical distiller characteristics are having a large surface area for receiving and condensing compared to a conventional single-slope distiller. To achieve the maximum possible utilization of this feature, in first the  $\text{Al}_2\text{O}_3$  nanoparticles were adding to the basin water to increase the evaporation rate, in the second modification the glass cover cooling technology was utilized to increase the condensation rate. To investigate the influences of  $\text{Al}_2\text{O}_3$ -water nanofluid and the glass cover cooling technology by a water sprinkler on hemispherical solar distiller performance, three hemispherical solar distillers were designed and tested in the same climate conditions. The first is the reference case (conventional hemispherical solar distiller), second is the modified hemispherical solar distiller with  $\text{Al}_2\text{O}_3$ -water nanofluid, and the third is the modified hemispherical solar distiller with  $\text{Al}_2\text{O}_3$ -water nanofluid and water sprinkler. Three different concentrations of  $\text{Al}_2\text{O}_3$  nanoparticles 0.1, 0.2, and 0.3% were studied. Results showed that, the accumulative yield of traditional hemispherical solar distiller reached 3280 ml/m<sup>2</sup>/day, while the utilization of  $\text{Al}_2\text{O}_3$ -water nanofluid and the water sprinkler improve the accumulative yield to 6750, 6900, and 7250 ml/m<sup>2</sup>/day, with improvement 105.8, 110.4, and 121% of the volume friction of 0.1, 0.2, and 0.3%, respectively. Also, the improvement in the daily efficiency for utilizing the  $\text{Al}_2\text{O}_3$  nanoparticles and water sprinkler reached 105.7, 109.7, and 120.1% for nanoparticle concentrations 0.1, 0.2, and 0.3%, respectively as compared to the reference case.

**Keywords** Solar energy · Nano- $\text{Al}_2\text{O}_3$  · Hemispherical solar still · Water sprinkler · Constant water flow rate

## Abbreviations

$A_s$	Absorber area
$h_{fg}$	Latent heat
$\eta_{\text{daily}}$	The daily efficiency
$\sum \dot{m}_d$	Accumulative yield

## Subscripts

CHSS	Conventional hemispherical solar still
MHSSN	Modified hemispherical solar still with $\text{Al}_2\text{O}_3$ -water nanofluid
MHSSNS	Modified hemispherical solar still with $\text{Al}_2\text{O}_3$ -water nanofluid and water sprinkler
SSSS	Single slope solar still

## Introduction

A drinking water crisis is one of a most prominent challenges facing humanity today, and studies indicate that the scarcity of drinking water will become the crisis of the twenty-first century (Kabeel et al. 2018). The issue of drinking water is the problem of our times, and humanity is more threatened than ever before (Kabeel and Abdelgaied 2019;

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