



Sand dunes effect on the productivity of a single slope solar distiller

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Abstract

Access to drinking water in many parts of the globe is shrinking over the years and much of the water resources are polluted or unpurified. North Africa is facing a huge water shortage due to drought and climate change. Water desalination has become very popular and serves as solar distillation which is proving to be an economical, simple and ecological technique, especially in rural and remote areas. Significant efforts have been made by many researchers in various laboratories to increase and improve the productivity of solar greenhouse distillation. In the present work, emphasis has been placed on the study of a single slope solar distiller having as dimension 50×50 cm, in the thickness of the impure water is 1 cm. Natural sand dunes from the El Oued South region of Algeria have been tested as a factor of efficiency improvement. A layer of this sand was deposited on the bottom of the distiller covering the whole surface on which the submit water is emerged. The results show that the productivity of distilled water has unfortunately decreased by 1.46 times.

Keywords Desalination · Drinking water · Solar distiller · Evaporation

Nomenclature

M_{ew}	hourly condensate production ($\text{kg/m}^2 \text{ h}$)
L_{fg}	latent heath (kJ/kg K)
A	area (m^2)
$I(t)$	solar irradiance (W/h)
T_a	ambiant temperatue ($^{\circ}\text{C}$)
T_w	water temperature ($^{\circ}\text{C}$)
T_s	Sky temperature ($^{\circ}\text{C}$)
η_{th}	thermal efficiency (%)
η_{pe}	passive exergy efficiency (%)

Ex_{output}	the hourly exergy output efficiency (W/m^2)
Ex_{input}	the hourly exergy input efficiency (W/m^2)

1 Introduction

The drought and observed climate changes which have prevailed for many years in North Africa have had a negative impact on drinking water resources [1]. Faced to with these

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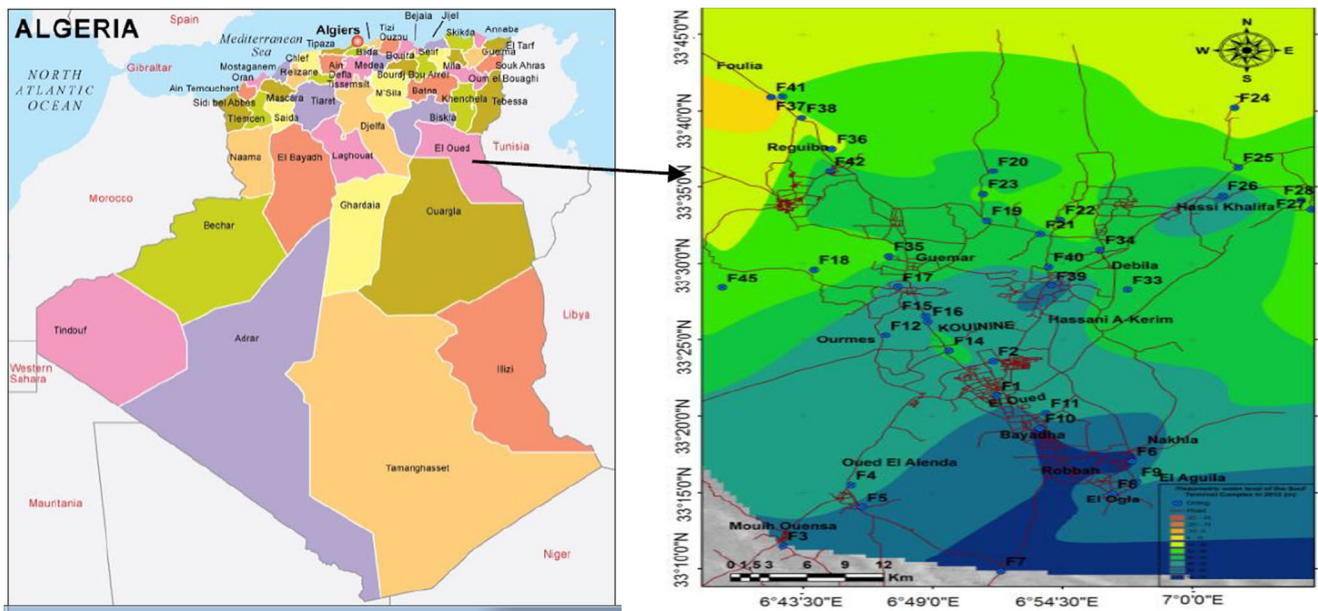


Fig. 1 Water Disposal Map of groundwater in the El Oued-Algerie region

challenges, Algeria has adopted the phase change process liquid to vapor as a solution [2]. The efficiency of this technique is relatively low compared to other modes but it remains the most economical way to desalt water. The low-cost solar distiller can be studied, designed, and improved with simple methods in order to provide water for communities living in remote or arid areas. It can also be used to remove fluoride [3]. The region of El Oued, like all regions of southeastern Algeria, is catastrophically affected by a high level of fluoride in deep waters, The Fluorine rate that varies between 0.8 and

4.3 mg / l depending on the different regions and this largely exceeds the standard adopted guideline values 0.8 mg/l published by the World Health Organization (WHO) [4, 5]. This excess causes a huge health and economic problem, thousands of families buy daily filtered drinking water distributed by tank cars. This situation prompted researchers to conduct local studies [6, 7] which aims to improve and perform a small solar distillation station under the actual insolation for underground water desalination of affected water in arid regions at southeast of Algeria. The small station has a daily capacity

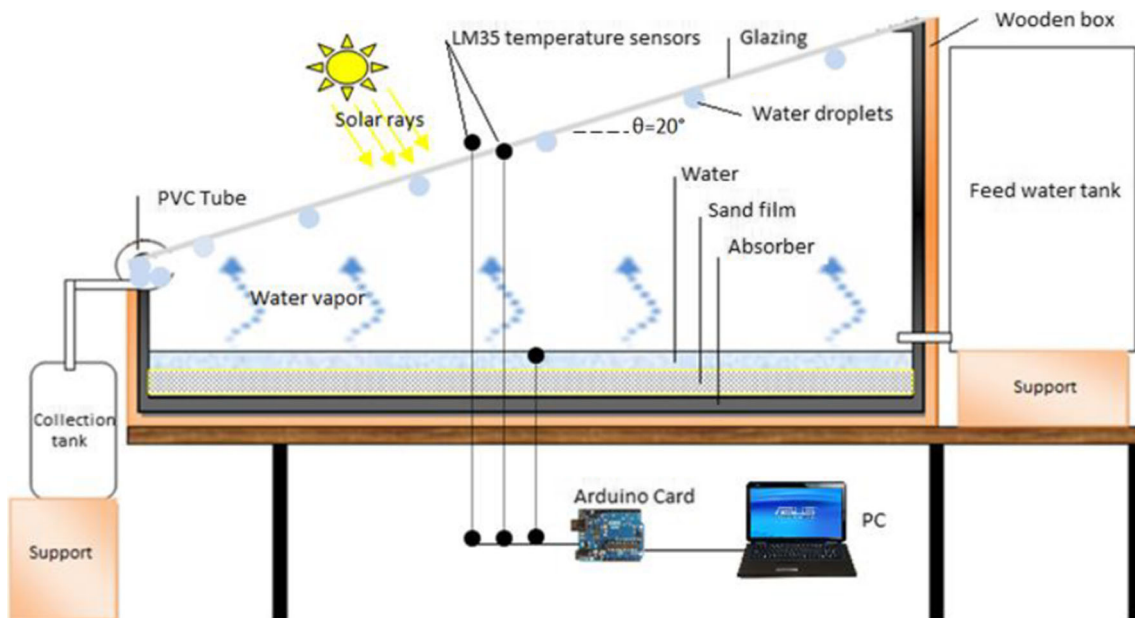


Fig. 2 Schematic representation of the single slope solar distiller

6 Conclusion

The two solar stills are geometrically similar and they worked under the same weather conditions. The cover, water and temperature gradient are the same but we note that the production and efficiency are different. The distiller without sand produced $3.8708 \text{ L} / \text{m}^2 / \text{day}$ and distiller with sand produced $2.7352 \text{ L} / \text{m}^2 / \text{day}$. The productivity ratio between the two distillers is 1.46 times. The energy and exergy efficiency of the distiller D1 is 38.27 and 24.51% higher than the distiller D2. The sand in the bottom of D2 is not suitable to improve the yield. The D1 distiller has refunded the amount of money invested for its construction in 30 days whereas D2 distiller has refunded the amount in 45 days.

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