International Journal of Energetica (IJECA)
https://www.ijeca.info
ISSN: 2543-3717 Volume 4. Issue 2. 2019
Page 54-57

Effect of heat flow via glazing on the productivity of a solar still

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Abstract – *In many parts of the world, particularly in the Greater Maghreb, desalination of water by solar energy is practiced with incredible abundance. Drinking water shortage has become a major problem. Improving the efficiency of solar distillers in several laboratories around the world is still one of the major concerns of research topics. In this work we want to show that the heat flow through the glazing can also be considered as an index on the productivity of pure water from a conventional solar still.*

Keywords: *Solar energy; solar distiller; distilled water; drinking water.*

Received: 26/11/2019 – Accepted: 25/12/2019

I. Introduction

The technique of water desalination in several countries is very developed, but each technique used in this field has its advantages and disadvantages [1-3]. Solar distillation is one of the simplest and most profitable purification techniques compared to other distillation methods because it uses a green and renewable energy source, it is solar energy. solar radiation and the main parameter in this technique and any variation of the solar intensity directly influencing the productivity of pure water in other words, the variation of the seasons has a remarkable influence on this type of distillation and this has been proven by an experimental study is made in the south-east of Algeria [4, 5]. The performance of this procedure is relatively low, but several research studies around the world have aimed at improving the production of solar stills using several techniques. Studies have focused on heating the water to be distilled, have used storage materials [6, 7], others have used a collector and a solar concentrator. Even solar PV has been used to increase water temperature in order to speed up evaporation [8, 9]. Nanofluid technology has touched the field of solar distillation and this through experimental studies done at the levels of several research laboratories [10]. The glazing of the distiller (condenser) plays a big role in solar distillation [11]. The temperature between the glazing and the water to be distilled is a good indicator of the production of pure water. Each time the temperature difference increases this will be followed by an increase in production. This indicator is the temperature gradient [12].

In this work we show that the heat transfer through the glazing in a solar still can be considered as a new indicator on the production of pure water.

II. Method and discussion

II.1. Description of the solar distiller

Figure 1 shows a solar still, this device which can be easily designed by equipment available in the markets. It is designed essentially from a wood box, a glass cover and a PCV tube.

Figure.1. Single slope solar distiller

II.2. Thermocouples locations

Temperature measurements are made by means of five thermocouples positioned as shown in Figure 2.

• Temperature of the inside face of the glazing.
• Temperature of the outside face of the glazing.
• Ambient temperature.

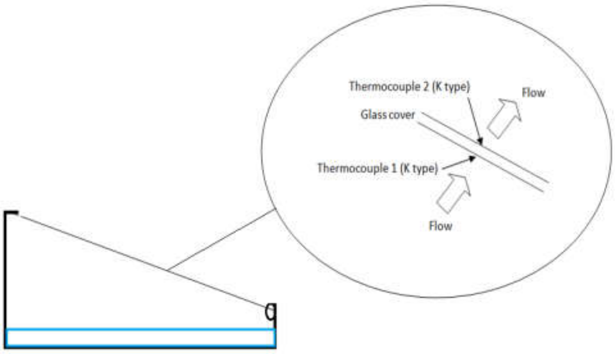

Figure.2. Locations of the used thermocouples

II.3. Characterization of glass

Glasses constitute an extremely varied set of products whose properties are innumerable. These depend mainly on the composition, especially thermal.

The thermal conductivity of the glass: 1 W/(m K)
Glass thickness: 0.004 m
Glass surface: 1/4 m²
Specific heat Cp: 0.8 J/g/K

II.4. Meteorological conditions of the experiments

An experiment was carried out at the University of El-Oued (south-eastern Algeria). The experiment was made on May 5, 2018 during a clear and calm windless day. Table 1 shows the experimental weather conditions.

TABLE 1
METEOROLOGICAL CONDITIONS

	(Summer May 5, 2018)
Sunrise	05:41 am
Sunset	07:19 pm
Ambient temperature	26-35°C
Atmospheric pressure	1013 mb

III. Result and discussion

There are many meteorological factors such as solar radiation; the ambient temperature influences the operation of the distiller. The transfer of heat through the glass cover is a remarkable indicator on the productivity of the solar still. The results obtained are illustrated in the following figures.

III.1. Solar radiation evolution

Figure 4 shows the solar radiation evolution in W/m^2 during the day time (in hours). The radiation increases gradually until reaching a maximum value between 11:00h and 14:00h. Solar radiation is the key parameter in solar distillation.

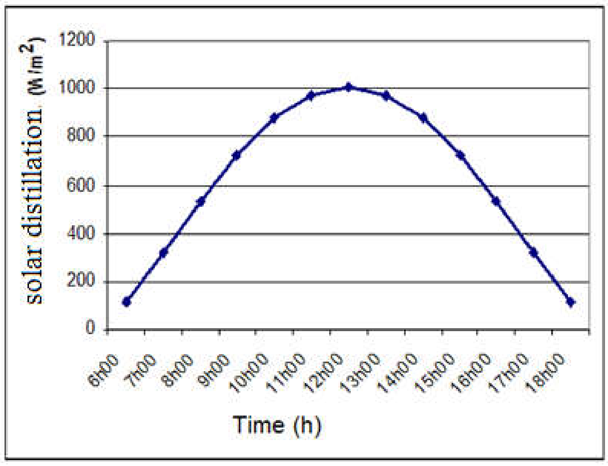

Figure.4. Evolution of solar radiation

III.2. Ambient temperature

Figure 5 shows the evolution of the ambient temperature as a function of time. The ambient temperature is growing until reaching a maximum value of 31 ° C and this at 15:00h. The ambient temperature is also a factor influencing the productivity of pure water from a solar still.

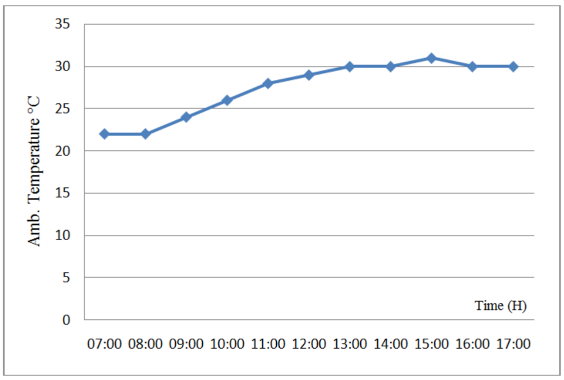

Figure.5. Evolution of ambient temperature

III.3. Variation in the temperature difference at the edge of the glass cover

Figure 6 shows the variation in the temperature difference at the edge of the glass cover of the solar still. This difference in temperature increases over time as well as productivity. This difference is maximum at 14:00h and the productivity is also maximum with 108.2 ml as shown in Figure 7.

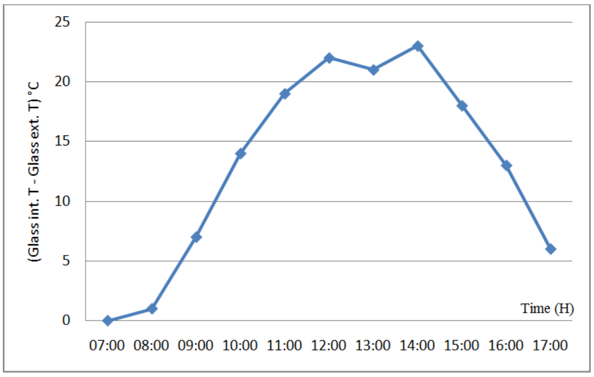

Figure.6. Evolution of the temperature difference at the edge of the glass cover

III.4. Productivity of pure water

Figure 7 shows the evolution of the pure water production as a function of time. The productivity is maximum at 14:00h and notes that the temperature difference between the two faces of the glazing is also maximum at 14:00h so we can say that there is a relationship between the outgoing flow via the glazing and the productivity of the solar still.

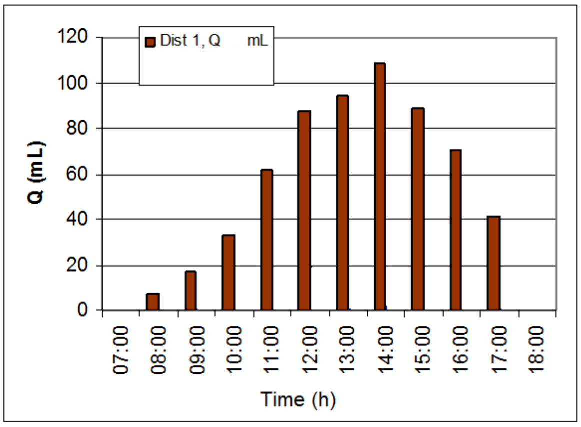

Figure.7. Productivity of distilled water

IV. Conclusion

In general, the temperature gradient is a good indicator to follow the productivity of pure water from a solar still, but we can say that the flow leaving via the glazing of a still may also be a productivity indicator. So we can say:

- The transfer of heat through the glass cover of a solar still gives a very remarkable indication of the productivity of the distilled water.
- This difference is maximum at 14:00 with (ΔT=31° C) and the productivity is also maximum with 108.2 ml

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