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Palm Fibers Effect on the Performance of a Conventional Solar Still

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ABSTRACTS

The lack of drinking water is one of the most important. Solar distillation remains the simple and effective solution to solve this problem, but the yield of solar distillation is low. However, the thermal performance of the solar still is low. Several researchers have made various experimental modifications to improve thermal performance. In this experimental modification, palm fibers were introduced to improve the performance of a solar still. The results showed that when using palm fibers there was an improvement of 35.6 % compared to the conventional still.

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1. INTRODUCTION

The lack of drinking water in the world is a real problem despite the large underground water reservoirs. Unfortunately, this water is not always drinkable, it is affected, polluted, or salty. This is why it is necessary to have a simple and sustainable solution that can adapt to isolated areas. One of the solutions is solar distillation.

The solar destination is a very affordable and very effective technique in isolated areas. It transforms polluted water into pure water using only free irradiance (Panchal *et al*., 2020; Kumar & Said, 2021; Khechekhouche *et al*., 2020). The solar still itself is very simple to build but unfortunately, its yield is low compared to other distillation methods (Khechekhouche *et al*., 2019). For a long time, the scientific community has been trying with all possible means to improve the performance of the solar still.

Research groups have used external and internal refractors to get better output from their devices (Essa *et al*., 2021; Khechekhouche *et al*., 2019). Another study tried to cool the glass cover of the still to accelerate evaporation and have a better output of pure water (Khan *et al*., 2021). On the other hand, another group tried to vary the angle of this cover and see its influence on the performance of the distillers. I

n the same context, other research has varied the thickness of this cover to examine its effect on the efficiency of the solar still (Cherraye *et al*., 2021; Panchal, 2016; Khechekhouche *et al*., 2020; Khechekhouche *et al.,* 2017). The double glass cover is an effective technique for the solar collector but not for the solar still and this has been proven by experimental studies (Laaraba & Khechekhouche, 2018; Khechekhouche *et al.*, 2021; Khechekhouche *et al.*, 2021).

The incorporation of materials either natural or industrial in the basin of the solar still is a well-known method and many studies have used different materials such as aluminum, zinc, stone, gravel, sand or others (Attia *et al*., 2021; Khechekhouche *et al*., 2020; Khamaia *et al*., 2022; Khechekhouche *et al*., 2019). Des études plus poussées et plus complexe en utilisées des matériaux a changement de phase et les nanofluides pour avoir un taux d'amélioration élevée (Kumar & Said, 2021; Abdelgaied *et al*., 2022).

Two solar stills of the same size and in the same climatic conditions were tested to use a local natural material very available in the region which is the fibers of the palm trees. The purpose of our study is to see the effect of this material on the output of a conventional solar still.

2. METHODS

The region of El Oued southeast of Algeria is well known for its palm farms. Each year the palm trees are harvested and cleaned. Large quantities of these fibers are accumulated for use in the local industry.

The idea is to use this material in solar distillation as shown in **Figure 1**, then two solar stills were exposed to the sun, one is taken as a reference solar still SSR and the other is taken as a distiller modifies SSM that is to say with only one modification it is the presence of palm fibers pieces. Measurements are taken every hour during the 8 hours of the experiment.

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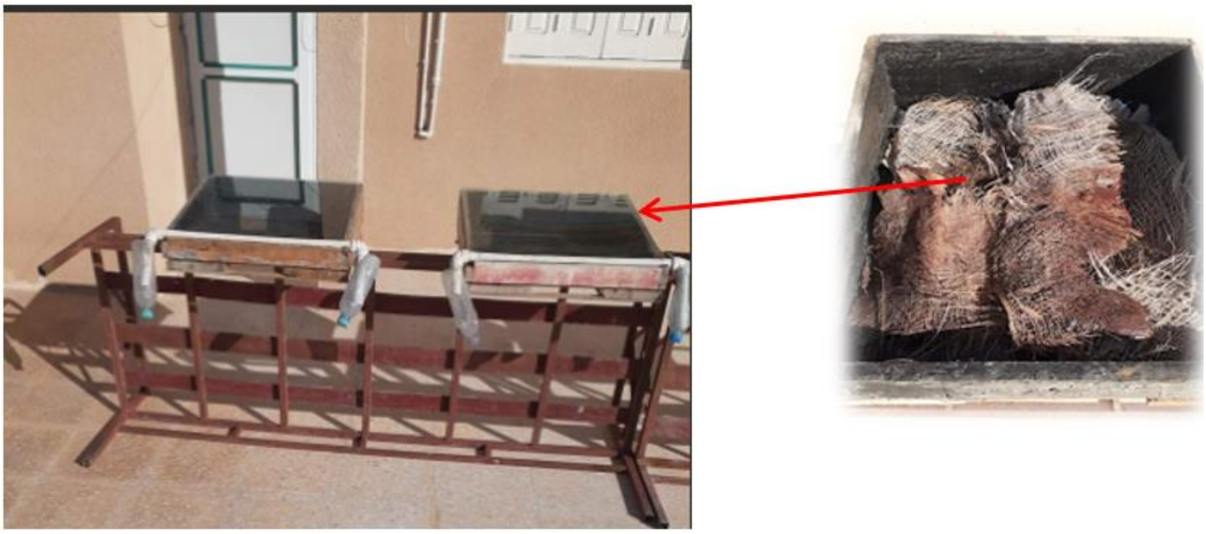

Figure 1. Experimental Setup.

3. RESULTS AND DISCUSSION

3.1. Solar Radiation and Ambient Temperature

Solar radiation and a very important bill in solar distillation. **Figure 2** represents the evolution of this radiation as a function of time. It shows also the evolution of the ambient temperature over time. Note that the maximum radiation is 700 W/m^2 between 12:00h-13:00h, and the maximum ambient temperature is 23°C at 13:00h. Its values are quite low because the experiment was done in February during the winter.

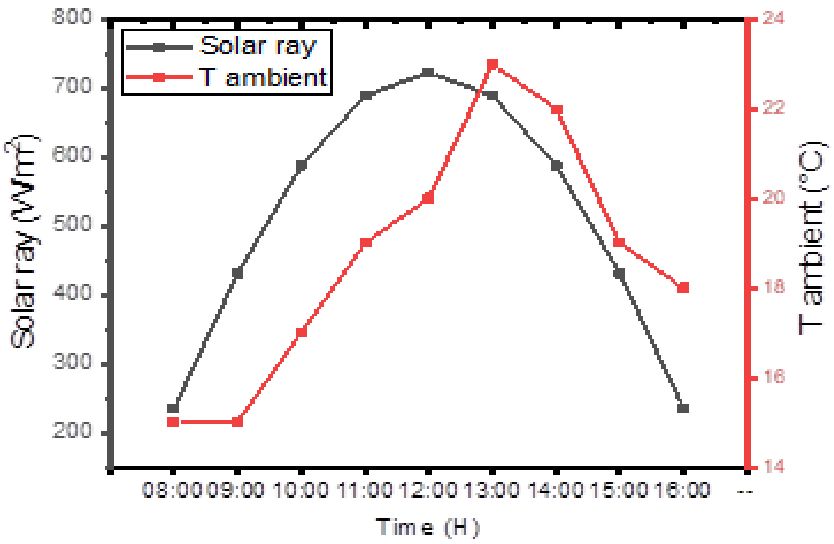

Figure 2. Evolution of Solar Radiation and Ambient Temperature.

3.2. Glass Cover Internal and External Temperature

Figure 3 represents the temperature variation on either side of the glass cover as a function of time. There is a large difference between the two temperatures of the inner faces. The maximum values obtained are 23 and 25°C for the SSR and SSM stills respectively.

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On the other hand, the temperatures of the outer face of the glass are almost the same as shown in **Figure 4**, and this is due to the low ambient temperature. The heat transfer is done quickly on this face and the face is cooled quickly and maintains almost the same temperature.

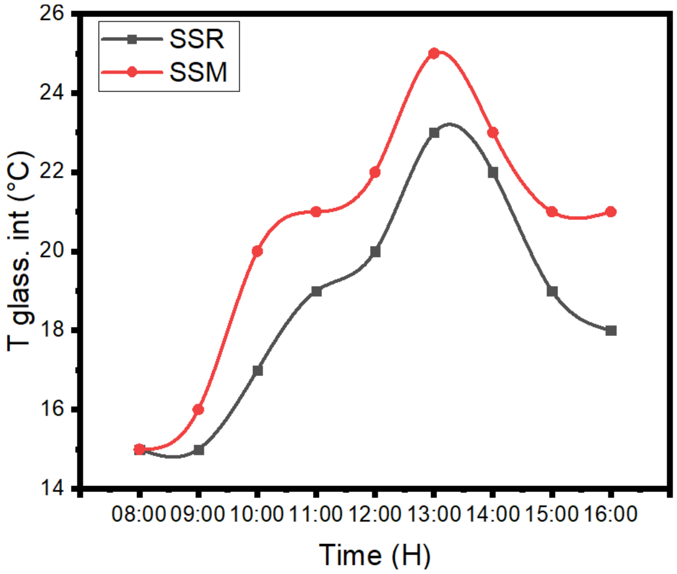

Figure 3. Evolution of Internal Glass Cover Temperature.

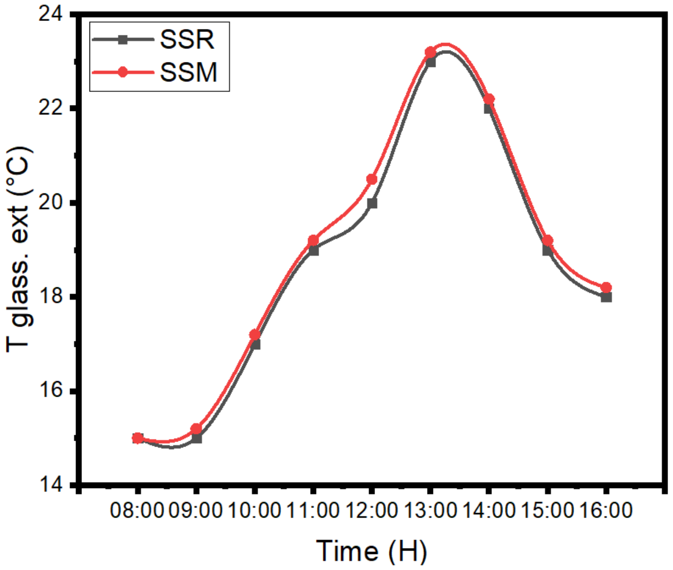

Figure 4. Evolution of External Glass Cover Temperature.

3.3. Water Temperature Evolution

Figure 5 represents the evolution of the water temperature of the two solar stills as a function of time. Notice a wide difference between SSR and SSM stills and that along with experience. The maximum value of this difference is obtained between 13:00h and 14:00h in the values are 25 °C and 35 °C for the SSR and SSM respectively. It is noted that the only difference between the two distillers is in the presence of palm fibers. The water pH changed from 7.90 to 7.09, while the electrical conductivity changed from 10180 (µs/cm) to 38 (µs/cm).

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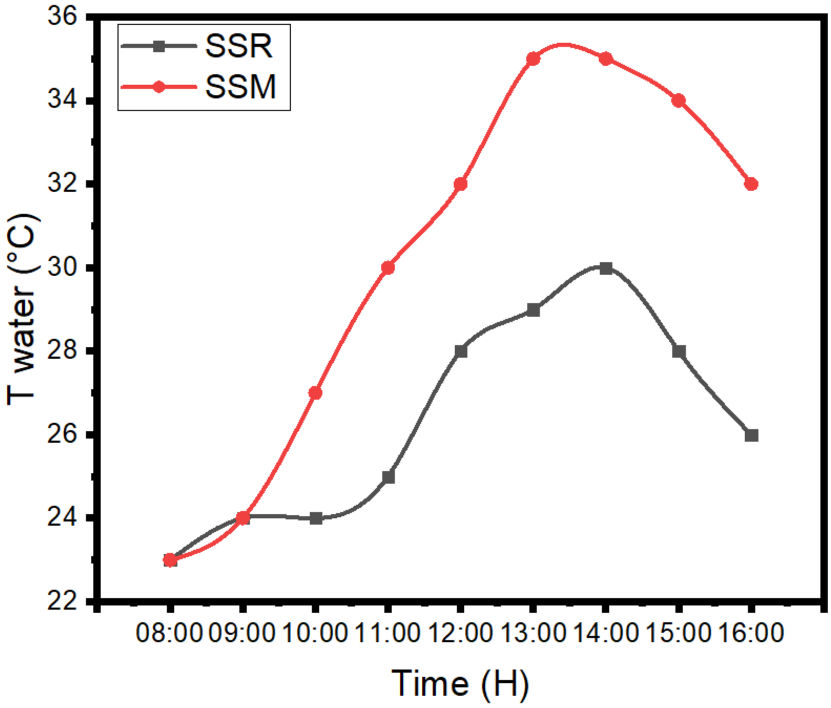

Figure 5. Evolution of Water Temperature.

3.4. Hourly and Accumulation Output of Pure Water

Figure 6 shows the hourly output and accumulation of pure water for the two stills versus time. We notice that the output of SSM is superior to that of SSR and this is in each measurement. The highest value of the output was at 14:00h in the value is 105 ml and 80 ml for SSM and SSR respectively. The total accumulation value is 444 ml and 602 ml for SSM and SSR respectively, as shown in **Figure 7**.

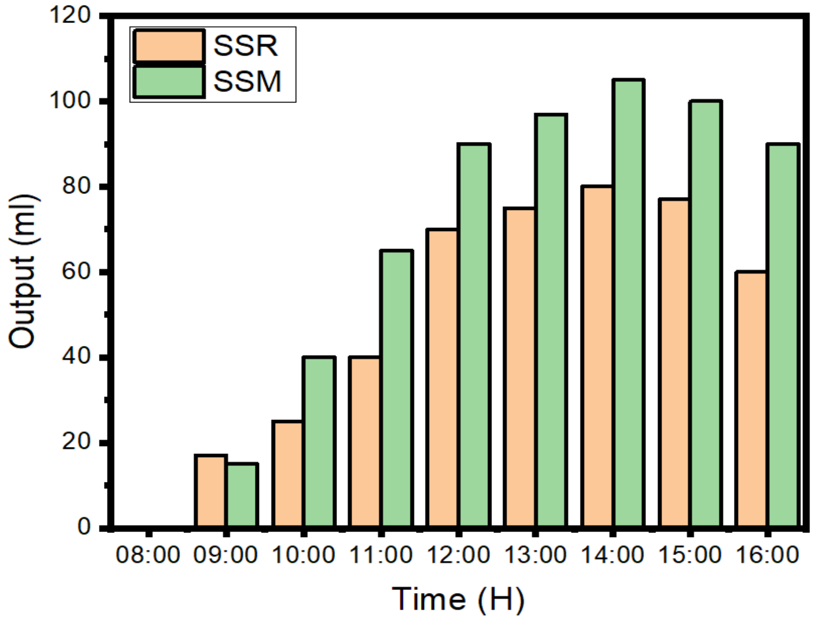

Figure 6. Evolution of Hourly Output.

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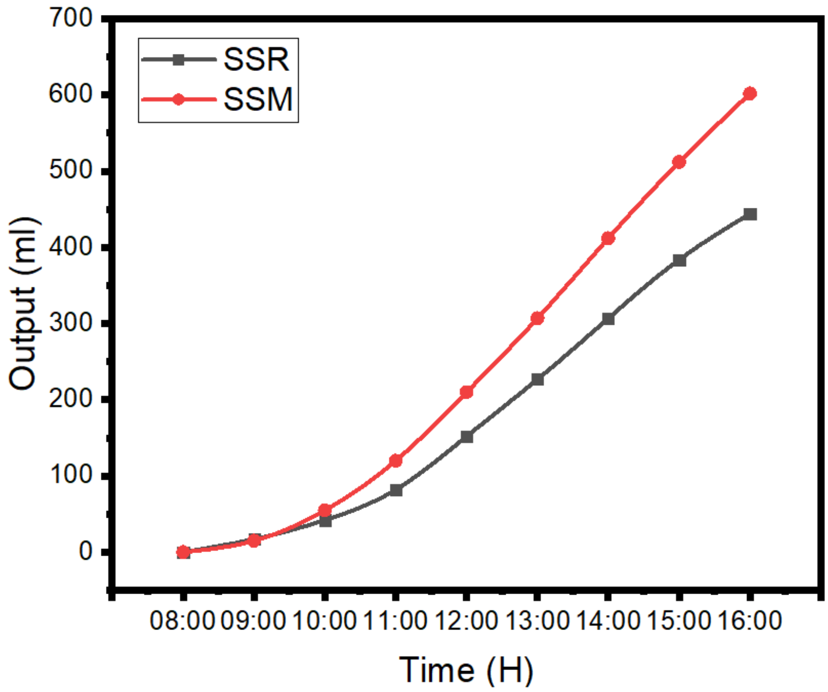

Figure 7. Evolution of Accumulation Output.

4. CONCLUSION

The research objective was met, having the results from two conventional solar stills of the same size. One is taken as SSR reference and the other modified distiller SSM which contains palm fiber. The results show that:

(i) The average basin water temperature of SSM is 30.2°C while for SSR is 20.5°C.

(ii) The rate of improvement due to the presence of palm fiber is 35.6%.

The good effect of the fiber on the performance of the solar still for collecting water is evident, which guarantees sustainability by taking advantage of local waste.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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