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Aluminum Wastes Effect on Solar Distillation

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ABSTRACTS

Aluminum wastes are widespread in the El Oued region of south-eastern Algeria, particularly in Aluminium workshops and factories. Because aluminum has a high heat conductivity, it can be used to increase the performance of solar stills. Two comparable solar stills were tested for this; one was used as reference solar still SSR, while the other contained Aluminium waste and was used as a modified solar still SSM. When compared to the reference still SSR, the results demonstrate that there is a 33.72 % improvement.

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1. INTRODUCTION

Solar energy is certainly clean, renewable, and environmental energy but it is not uniformly distributed on earth. The same for drinking water. On our globe, some areas suffer from the unavailability of drinking water, which is why solar distillation is one of the most favorable solutions for this problem. In isolated and remote areas, it is sometimes difficult to find drinking water. The inhabitants are forced to find a solution that transforms polluted water into drinking water. The solar distillation of polluted water and the construction of solar stills have been the research objects of many scientific laboratories (Sadasivuni *et al*., 2020; Panchal *et al*., 2020; Khechekhouche *et al*., 2020a; Khechekhouche *et al*., 2019a). The solar stills used in isolated areas have a fairly low yield, which is why a lot of research is trying to improve this performance by incorporating other energy systems such as the flat solar collector, the parabolic concentrator (Wang *et al*., 2022), the cylindrical concentrator parabolic (Essa *et al*., 2022), photovoltaic (Hansen *et al*., 2021) and many others. Other studies have used less complex and easier methods, and by varying the thickness, the angle, or the glass cover number of the solar still (Cherraye *et al*., 2020; Panchal, 2016; Khechekhouche, *et al*., 2021, Khechekhouche, *et al*., 2019b; Khechekhouche, *et al*., 2017). Solar still experiments have used both external and internal refractors to get better performance from their devices (Khechekhouche *et al*., 2020b). Others have attempted to cool the glass lid of the still to accelerate evaporation (Khan *et al*., 2021).

The use of local, natural, or industrial materials in the basin of solar stills is a very well-known technique and many experiments have used different materials in different forms such as aluminum, zinc, stone, gravel, sand, palm fibers, or others (Khechekhouche *et al*., 2020c, Khamaia *et al*., 2022, Khechekhouche *et al*., 2019c; Kermerchou, *et al*., 2022). Nanofluid technology is a recent method in the field of solar distillation. Much research has used the thermal properties of nanofluids to increase the performance of solar stills. This material is not available and it is expensive compared to local materials (Kumar, *et al*., 2021; Alarifi, *et al*., 2021, Elashmawy, *et al*., 2021).Two solar stills of the same size and in the same climatic conditions were tested to use the aluminum residues as factors for improving the performance of a conventional solar still.

2. METHODS

The experiment was carried out in the El Oued (Algeria) as shown in **Figure 1**. It entails using Aluminum residue to improve the production of solar distillation. Two comparable solar stills were exposed to the sun, one of which was designated as the SSR reference solar still and the other as the modified still SSM, which contained Aluminum residues. Throughout the day of the experiment, measurements are obtained every hour.

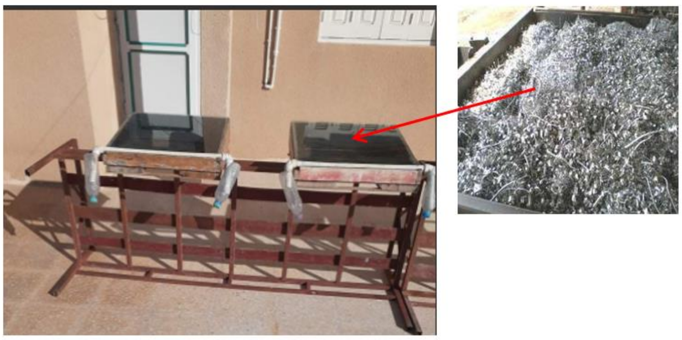

Figure 1. Experimental setup.

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3. RESULTS AND DISCUSSION

3.1. Solar radiation and ambient temperature

In solar distillation, sun radiation is a critical factor. The evolution of this radiation as a function of time is depicted in **Figure 2**. It also indicates how the ambient temperature has changed over time. The experiment was done in February in the winter so the ambient temperature is quite low. Between 12:00 and 13:00, the highest radiation is 749 W/m^2, and the maximum ambient temperature is 17°C.

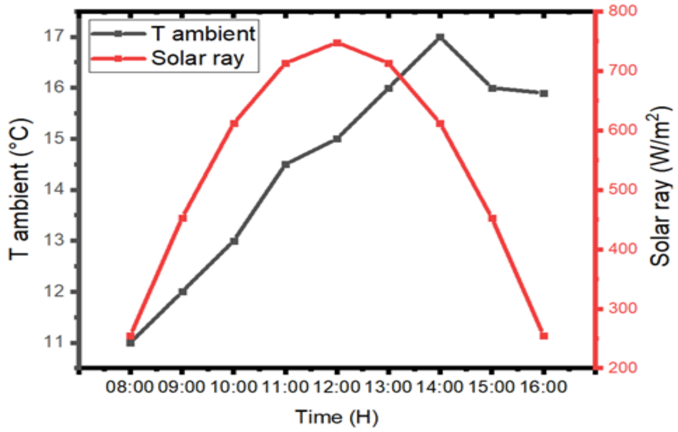

Figure 2. Evolution of solar radiation and ambient temperature.

3.2. Glass cover internal and external temperature

Figure 3 represents the evolution of the water temperature of the two solar stills as a function of time. From the start of the experiment, the difference between the SSR and SSM stills is apparent. Between 13:00 and 14:00, the maximum value of this difference is attained, with values of 31 and 36°C for the SSR and SSM, respectively. The presence of aluminum remains is the only difference between the two solar stills.

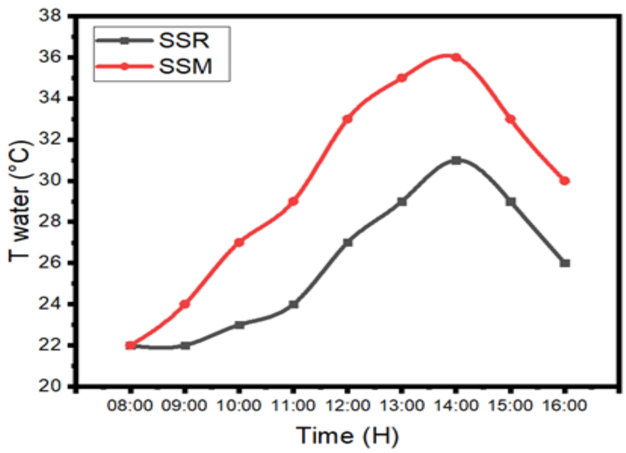

Figure 3. Evolution of water temperature.

3.3. Water temperature evolution

The temperature variation on either side of the glass cover concerning time is depicted in **Figure 4**. The two temperatures of the inside faces of the two stills are noticeably different from the start of the experiment. The SSR and SSM still achieved maximum temperatures of 20 and 22°C, respectively. The temperatures on the outside side of the glass are remarkably similar as shown in **Figure 5**, which is due to the low ambient temperature**.**

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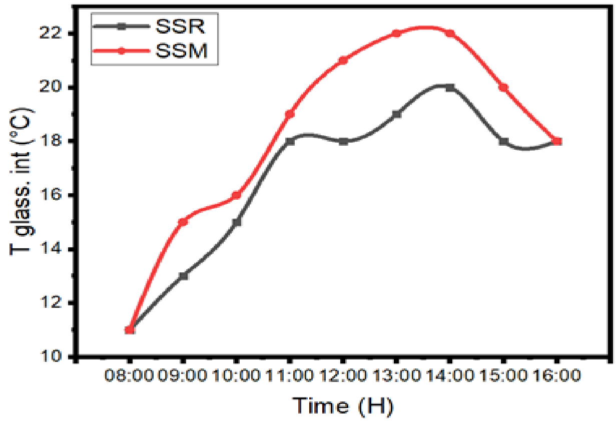

Figure 4. Evolution of internal glass cover temperature.

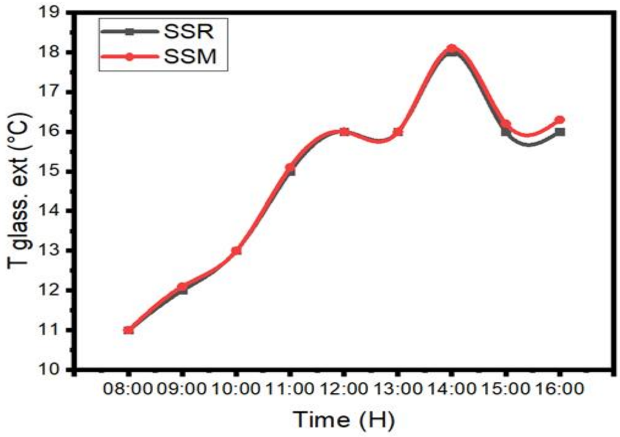

Figure 5. Evolution of external glass cover temperature.

3.4. Hourly and accumulation output of pure water

Figure 6 depicts the change in hourly production and pure water accumulation for the two solar stills as a function of time. We can see that the SSM's performance is superior to the SSR's in each of the eight measurement locations. At 14:00 the greatest value of pure water output was 109 mL for SSM and 80 mL for SSR, respectively. For SSM and SSR, the total accumulation value of output is 444 and 575 mL, respectively.

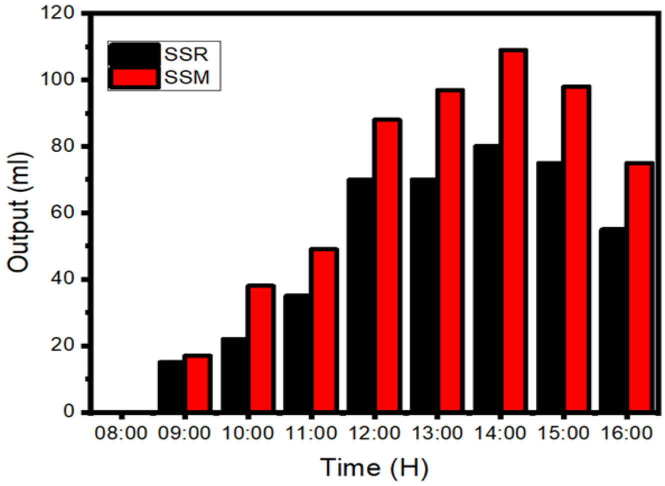

Figure 6. Evolution of hourly output.

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4. CONCLUSION

The experiment was carried out with two identically sized conventional solar stills. One is used as an SSR reference, while the other is a modified distiller SSM with Aluminum wastes. The results show that:

- The average basin water temperature of SSM is 29.8°C, whereas SSR is 25.8°C.
- The rate of improvement owing to the presence of Aluminum wastes is 33.72%.

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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