Enhancing efficiency and cost-effectiveness of solar stills through natural fiber integration

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Abstract. Various enhancements to solar stills aim to increase their output of fresh water. This research experimentally compared the efficiency of two solar stills (SS) in terms of producing fresh water. The conventional solar still (CSS) was compared to the Coconut leaf sheath single slope solar still. Natural fibres were used to fill the basin, increasing the surface area in contact with the sun and, by extension, the rate of evaporation. Utilize its capillary effect while simultaneously putting it to use as a heat sink (thermal storage material). We calculated the exergy and thermal energy efficiency of both systems and the associated costs. Daily accumulative freshwater productivity was found to be 5170.8 gm/m^2 when employing natural fibre, a 45.8 % improvement over the usual method. Solar stills made from natural fibres were discovered to have daily thermal energy efficiencies of 46.8 % and exergy efficiencies of 5 %, while CSS systems achieved 33.8 and 3.2 %, respectively. When compared to a standard solar still, which costs ₹9.68 every litre of water produced, a solar still made with natural fibre reduces that cost to just ₹6.64 per litre.

Keywords: Cost analysis, natural fibers, single slop solar still, thermal energy efficiency, desalination, exergy efficiency.

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1. Introduction

Humanity's most pressing problem is the growing scarcity of fresh water due to rising industrial production and population. Almost all of Earth's water is salt water, which can be treated in different ways to produce potable water. However, the total cost of freshwater production rises because to the extensive use of expensive energy sources required by these technologies. In recent years, renewable energy sources have grown increasingly accessible and practical for this function. Desalination with solar energy is a viable and inexpensive option with a low environmental impact. Salty water (seawater) or grey water can be converted into drinkable water via evaporation using solar stills [1]. To maximize efficiency and output, a solar still can make use of both passive and active solar thermal energy. Traditional solar stills can be modified in this way by employing novel materials, geometries, and building techniques [2]. Solar still performance was analyzed both experimentally and theoretically [3]. The experimental and theoretical values were completely consistent with one another [4]. The research also showed that solar intensity and the temperature of the incoming water had a direct bearing on the effectiveness of instantaneous stills. Humidification and dehumidification methods, as well as improvements to absorber plates, reflectors, and the utilization of nanoparticles, are discussed in the article [5]. Freshwater output was studied by researchers [6] who looked at the impact of environmental parameters like ambient temperature and wind speed, as well as design and operating characteristics such water depth in the basin and the use of dyes. The impacts of location, structure, and operation on solar still water production was analyzed [7].The efficiency of the solar still is found to improve with adjustments to environmental, chosen operating, and design characteristics. Water production is inversely related to evaporation area and basin water depth. Also investigated [8] were the energy and exergy efficiencies of both active and passive tilted SS. In terms of energy efficiency (16.89 %), exergy efficiency (47 %) and distilled water output (47 %) the active inclined solar still dominates the passive SS (57.08%) [9]. The cost of producing water using the active system was found to be less expensive (1.48 □/L) than using the passive system (2.38 /L). Efficiency of several SS designs was analyzed. Double or single basins, cascade stills, solar water heater integration, PCM as thermal storage, and pin fins are only a few of the technologies that have been developed to maximize efficiency [10]. The combined solar still with photovoltaic and water heater achieves the maximum exergy efficiency (13.8 %) and energy efficiency (53.10 %). Desalination efficiency was measured in terms of its thermodynamic effectiveness by determining the amount of energy needed to run the process. Exergy analysis [11] was used to determine the worth of this energy. The pros and cons of desalination systems powered by renewable energy sources vs those powered by traditional energy resources were uncovered in a recent study. Membrane processes and thermal phase change procedures were studied for these systems [12]. Incorporating a pulsing heat pipe with a high thermal energy conduction rate into a solar-powered desalination system improves the maximum value of fresh water output to around 875 mL/ (m^2.h) [13]. The efficiency of producing distilled water was improved by using a single slope still equipped with a solar air collector, solar flat plate collector, perforated pipes to spray water and warm air, condenser, and other components [14]. The designed device was put through a battery of passive and active tests, and compared to the standard model. Fresh water productivity was shown to increase across the board with the addition of the component [15]. Multiple groups of coaxial pipes, each having a unique amount of annular space in the still's basin, can transform a standard solar still into something new [16]. It was determined experimentally how thick the annular space was. Each of the four modified SS types produced at least 98 %, 74 %, 63 %, and 52.7 % more liquid than a standard SS [17]. Analyzing the characteristics of a conventional SS and a single-slope solar still, experimentally. A hybrid Nano fluid of antibacterial-magnetic Ag@Fe_3O_4/deionized water is produced using a single-slope still, a thermoelectrically equipped channel, and a concentrating evacuated-tube collector [18]. When compared to a standard solar still, the modified model is 117 % more efficient at using energy and 218% more productive at producing water. Another study found that the addition of phase transition materials increased solar still output by allowing the system to store more heat [19]. According to the findings, thermal storage materials have a greater impact during the night than during the day. Less water was used in the basin in comparison to the amount of storage materials, which increased output [20]. The fundamental component of a solar still, the condensation surface allows sunlight to pass through readily to condense evaporated water. Both dropwise and film wise condensation modes exist. Converting the film wise mode to the dropwise mode by coating the condensation surface with a Nano-silicon solution increases water productivity by 23 % for surfaces inclined at 50 degrees [21]. Nano-enhanced phase transition materials across a variety of solar system technologies have been the subject of numerous studies [22]. The advances in technology have led to better thermal conductivity and a lower melting point. Finned pipes leading to a reservoir of chilled water can be integrated into the design of the condensing surface to boost the condensation rate. The quantity of cooled water passing through the condenser and the density of fins on its surface are two variables that influence the yield of potable water. There are several methods for controlling the condensation and evaporation rates in SS. Phase transition materials, nanoparticles, thermoelectric techniques, and other similar approaches [23]. In order to make fresh water from salt water, researchers tested a single slop solar still in a hot, dry area. The single slop 's glass cover is slanted so that only one side receives direct sunlight for an effective length of time; this helps to maintain a cool surface temperature for the condensed material inside [24]. The basin is constantly filled with seawater at a set level. Over the course of the day, 3230 grammes of fresh water were produced. It was determined that the system's exergy efficiency was 2.35 percent and its energy efficiency was 31.6 percent. The cost benefit analysis is also performed. Single slop solar stills with sponges in their basins produce more distilled water because the sponges increase the surface area available for evaporation [24]. Adding a tank of PCM under the absorber surface of a single slop solar still and putting circular fin tubes at the absorber surface was tested to see if it increased the still's efficiency. Corrugated plate is utilized to maximize the basin's solar energy absorption area. After dark, the water's thermal energy needs are met by the addition of phase change material. Research into the use of distilled water has, as has been mentioned, as its fundamental purpose the enhancement of efficiency and effectiveness. Improvements were made to every facet of the solar still as a result of modifications to its construction design variables, geometry, materials, and operating circumstances. There are also numerous additives on these parameters that apply to the same domains. Coconut leaf sheath and other natural fibres are considered renewable resources since they are biodegradable and good for the environment. This research tested the efficacy of a quadrilateral single slop SS made of natural fibre (coconut leaf sheath) with a basin to increase fresh water production from seawater in arid environments.

2. Experimental setup

2.1. Methods and materials

The tests were performed in two single slop solar stills with quadrilateral bases, each containing a galvanized steel basin with a black coating (1 × 1 × 0.1 m). Because sun intensity is expressed in terms of watts per square meter, the primary parameter for all other factors is assumed to be 1 square meter of basin surface area. Polyurethane foam G3000 was used to insulate the inside of the wooden box that housed the stainless-steel basin. A square single slop of steel 1 m in height, with a cover of transparent glass 4 mm thick. According to authors [25], it was found that a glass cover with an inclination greater than 20 degrees is preferable because it prevents the detachment of a high number of condensed droplets that slide underneath the slanted surface. The seawater is supplied via a two-hundred-liter tank that is coupled to a feeding system of unique design via a smaller, graduated tank. An autonomous floating valve maintains a steady seawater level in the basin throughout the day of testing. Seawater seeps in from below, while distilled water drops roll along the glass and pool in the appropriate indentations. On June 11, 2022 (the day of the year (n) = 162, experiments were run from 9:00 a.m. to 5:00 p.m. Density was found to be 920 kg/m^3 and pore volume was found to be 0.1046 cm^3/g for the coconut leaf sheath we utilized. A catalogue of supplementary features. About 1.3 kilos of fibre was consumed. Natural fibres (coconut leaf sheath) were employed to increase surface area exposed to the sun and speed up the evaporation process. Table 1 further demonstrates the usefulness of natural fibre and saline seawater as thermal storage materials for facilitating water evaporation during times of low solar intensity.

Table 1. Analyzing a seawater sample.

Sample	pH	TDS	Turbidity
Sea water	7.9	97,000- PPT	0.54

CSS performance metrics were compared to those of a variant containing natural fibre. The two systems' energy, exergy, and monetary costs were analyzed.

2.2. Setup of an experimental setting

Fig. 1 displays the primary parts of the experimental equipment in its final arrangement. The experimental design is as follows: The experiment was carried out using a pair of identical single slop solar stills. Both were oriented towards the south, with one housing a standard single slop solar still and the other containing natural fibres in its basin. Two special-design feeding systems, previously linked to the basin, were used to keep the seawater level in a 200-liter tank (assumed to be 3 cm) at a consistent level during the experiment. Table 2 displays the results of an analysis performed on data gathered from an AcuRite 01009 M Atlas weather station at a time step of 30 seconds. Pyranometer of the silicon-based Pogee SP-420 type, measuring sun intensity in watts per square metre (from 0 to 2000, with precision = ±5 %). Temperatures were measured and recorded using a collection of ANSI T-type thermocouples connected to a USB-2408 Data Acquisition system (DAQ) with CJC (temperature range: -200 to 200°C, accuracy: 0.1°C). The mass in grammes of the collected distilled water. As can be seen in Fig. 2, we set up two solar single slopes with the same number of sides. There were some strands that were above water and some that were submerged in the basin. Because of their capillary qualities, natural fibres soaked up water from the basin, exposing more of the water to the sun. As a result, the seawater evaporated more quickly. The mechanical feeding mechanism kept the water level in the basin at a consistent 3 cm during the experiment. In addition to allowing sunlight to reach the water's surface, as seen in Fig. 2, the use of a transparent glass lid also created an effect of greenhouses, which kept temperature in the space between the lid and the water's surface. As the temperature increased, the liquid evaporated. Because the surface temperature was below the vapor temperature, condensation occurred under the glass cover. Condensation forms on the glass cover and drips into the lower tray, where it is collected.

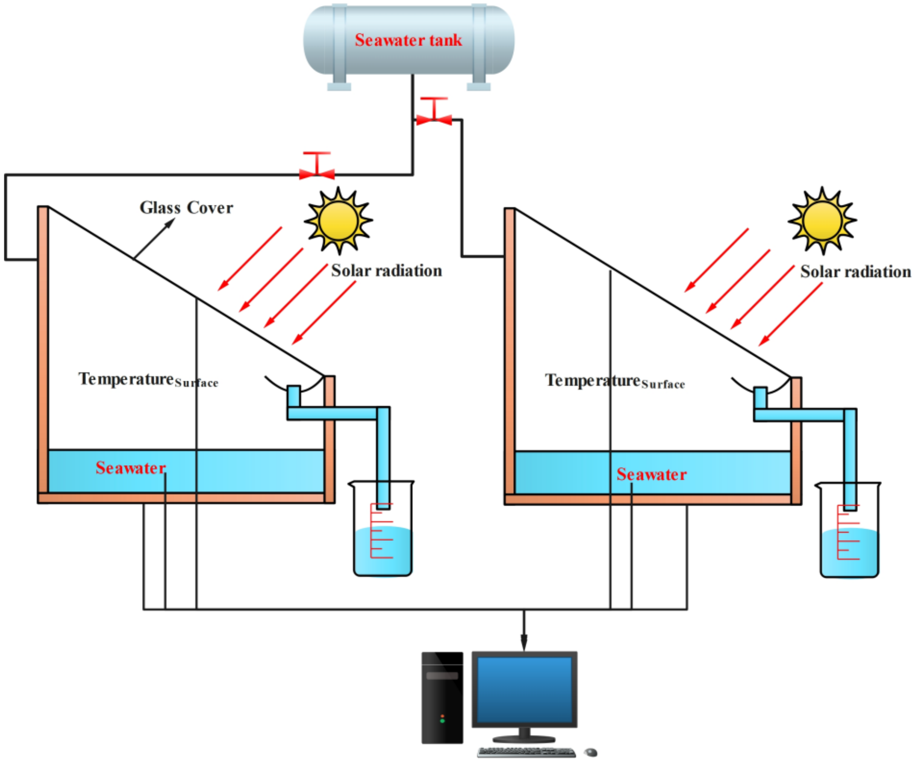

Fig. 1. Experimental setup configuration.

Table 2. Specification for an Atlas module used in an AcuRite 01009 M weather station.

Parameter	Accurate	Limit
Wind direction [degree]	±3.0	0 to 360
Wind speed [m/s]	±0.4	0 to 71
Ambient temperature [°C]	±0.5	− 40 to 70

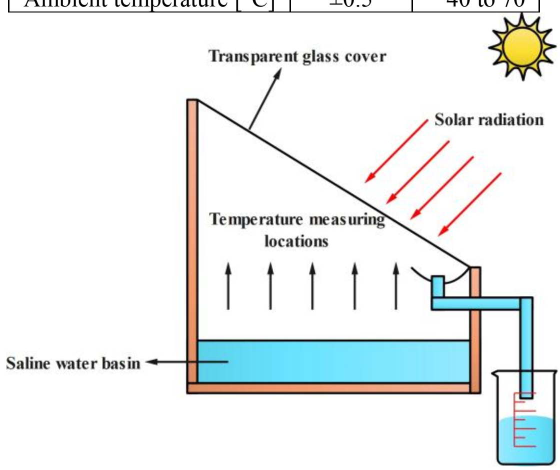

Fig. 2. Diagrammatic representation of thermocouple locations.

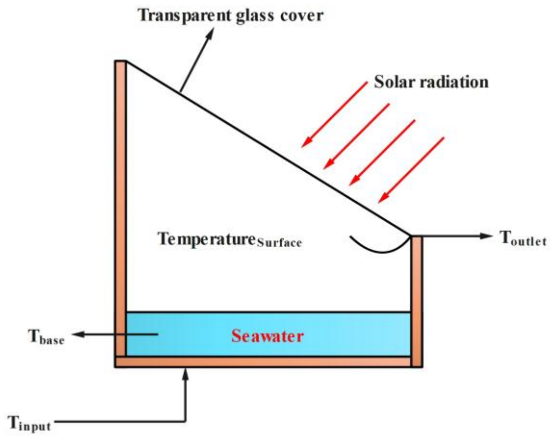

Fig. 3. Diagrammatic representation of thermocouple locations.

As seen in Fig. 3, a thermocouple has been installed in a single slope-shaped solar still to facilitate temperature measurement. The inside surface temperatures were measured by attaching thermocouples to the same point on each of all four sides of both single slope SS glass covers in the same sequence.

2.3. Experimental process

The solar stills are kept at a constant seawater level of 3 cm by an automatic feeding system that operates when the storage tank's valve is opened, filling the basin. The tests lasted for eight hours, from eight in the morning until four in the afternoon. Purified water was collected and weighed continuously during the duration of the experiment. The total weight of distilled water over the course of an overcast day and night is recorded here. Four thermocouples, one affixed to the interior of each face of the single slope, monitored the surface temperatures of the glass during the experiment. The mean temperature (T) of the water within the basin, calculated by subtracting its surface temperature from its depth. The average temperature of condensed freshwater observed and recorded during the course of the experiment. A pyranometer affixed to the edge of the solar still records the solar radiation at regular intervals. A weather station was set up at the test site to collect data on the surrounding air's temperature, humidity, and wind speed and direction. The entire database was updated and analyzed.

3. Numerical analysis

3.1. Exergy efficiencies and thermal energy analysis

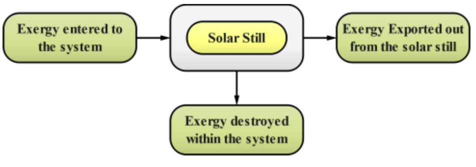

Fig. 4. Exergy analysis.

Due to the low cost of solar energy as an input relative to other energy sources, the efficiency of a solar still can be potentially maximized indefinitely. Solar still thermal energy efficiency is a function of solar radiation received, absorber surface area, latent heat of condensation and vaporization, and solar temperature, as well as the amount of distilled water produced per hour and per day. A solar still's thermal efficiency (η_{therm}, hour) is the ratio of the energy used to desalinate water to the solar energy input during the same time period. We calculated the SS daily thermal efficiency (η_{therm}, day) by adding up the amount of distillation to the amount of incident solar energy[26].

$$\eta_{\text{therm , hour}} = \frac{\dot{m} \times h_{fg}}{I(t) \times A_{\text{base}}} \quad (1)$$

$$\eta_{\text{therm,day}} = \frac{\Sigma(\dot{m} \times h_{fg})}{\Sigma(I(t) \times A_{\text{base}})} \quad (2)$$

Where;
$\dot{m}$ denote rate of distilled water productivity [kg/s]
I(t) denote solar radiation over the area of the basin [W/m^2]
A_{base} denote whole area of the base of basin.
Latent heat value (h_{fg} in [J/kg]) reported in [27] was calculated using the average basin water temperature ($T_{average}$, conventional, and $T_{average}$. fiber.).

$$h_{fg} = \left[2501.9 * 10^3 - 2.40706 \times 10^3\ \text{T}_{\text{average}} + 1.192217\ (\text{T}_{\text{average}}\right)^2 - 1.5863 \times 10^{-2} \left(\text{T}_{\text{average}}\right)^3\Big]\ (3). \quad (3)$$

One way to evaluate the efficacy of a system is to calculate its exergy efficiency, which is the amount of exergy produced relative to the amount of exergy used. Here is a rundown of the universal exergy-balanced equation: The total exergy input = to the whole exergy output + all of the system's inherent irreversibility (exergy destruction). Transportation of exergy from the sun is the input to the system, and it is computed as indicated in [28]

$$\text{Exergy}_{\text{ input}} = I \times A_{\text{base}} \times \left[1 - \frac{4}{3}\left(\frac{T_{\text{ambient b.}}}{T_{solar}}\right) + \frac{1}{3}\left(\frac{T_{\text{ambient b.}}}{T_{\text{solar}}}\right)^4\right] \quad (4)$$

T_{solar}, the solar temperature.

We can think of the exergy created by the system (SS) as the exergy of water evaporation, which is equal to the difference in temperature between the water in the evaporator (basin) and the ambient air. To calculate this number, utilize the one given in formula [20]

$$\text{Exergy}_{\text{ out}} = \dot{m} \times h_{fg} \times \left[1 - \left(\frac{T_{\text{amb b.}}}{T_{aagg}}\right)\right] \quad (5)$$

System exergy efficiency (η_{exergy}, hour) and system exergy efficiency (η_{exergy}, day) are computed as follows [15]:

$$\eta_{\text{exergy,hour}} = \frac{\text{Exergy}_{\text{ outlet}}}{\text{Exergy}_{\text{ input}}} \quad (6)$$

$$\eta_{\text{exergy,day}} = \frac{\sum \text{Exergy}_{\text{ outlet}}}{\sum \text{Exergy}_{\text{ input}}} \quad (7)$$

3.2. Analysis of cost

We compared the costs and benefits of each method.

$$Capital\ Recovery\ Factor, CRF = \frac{[i*(1+i)^n]}{[(1+i)^n-1]} \quad (8)$$

Where;
A solar panel is predicted to last for n years, where I is the annual percentage rate of interest.

$$\text{First Annual Cost, FAC} = \text{CRF} * (\text{Total Principal Cost, TPC}) \quad (9)$$

$$Sinking\ Fund\ Factor, SFF = \frac{i}{[(1+i)^n-1]} \quad (10)$$

$$Annual\ Salvage\ Value, ASV = (SFF) * (Salvage\ Value\ of\ the\ still, SV) \quad (11)$$

Assume 10% of the entire principal value as the salvage value (SV).
It is still envisaged that 15% of the FAC will go towards solar system maintenance.

$$Maintenance\ Cost, MC = 0.15 * (FAC) \quad (12)$$

$$System\ Annual\ Cost, SAC = FAC + MC - ASV \quad (13)$$

One liter of freshwater produced by a SS system cost as calculated by the following equations:

$$Cost\ of\ producing\ one\ liter\ freshwater = \frac{System\ Annual\ Cost}{Annual\ accumulative\ distilled\ water\ productivity} \quad (14)$$

4. Results and discussions

4.1. The Variations of environmental criteria

The average temperature for the day of testing was 40.4 degrees Celsius, with a high of 46.6 degrees Celsius at 1:00 p.m. Fig. 5 shows the variation in solar intensity ambient temperatures over the testing hours. The maximum solar intensity recorded for the day was 1168.3 W/m^2 at 1:00 p.m., with an average value of 885.6 W/m^2.

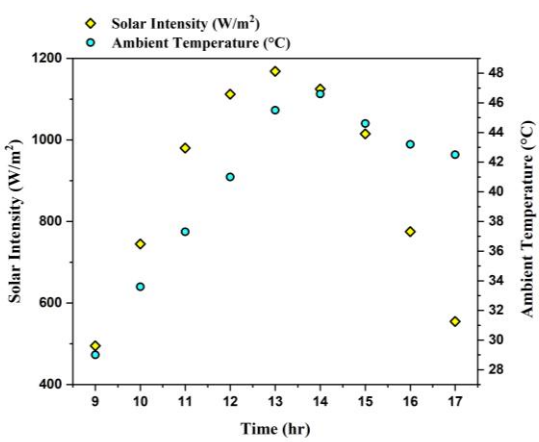

Fig. 5. Solar intensity and ambient temperatures difference over test day hours (12th of March 2023).

Temperature differences of the glass cover throughout the test day are displayed in Figure 6. The glass cover surfaces of both types of solar stills recorded the same temperatures over time. The results demonstrated a causal relationship between surface temperature change and solar radiation intensity. The readings of the east-facing surface temperature T3 were higher than those of other directions between 6 a.m. and noon. T1 is the surface that faces west and has the greatest recorded temperature in the afternoon, when the sun is at its maximum. The lowers were captured from T4 faces that were mounted facing north. Temperature (T1) had average daily temperatures of 51.9°C respectively, according to calculations.

4.2. The varying temperature of the single slope 's glass cover

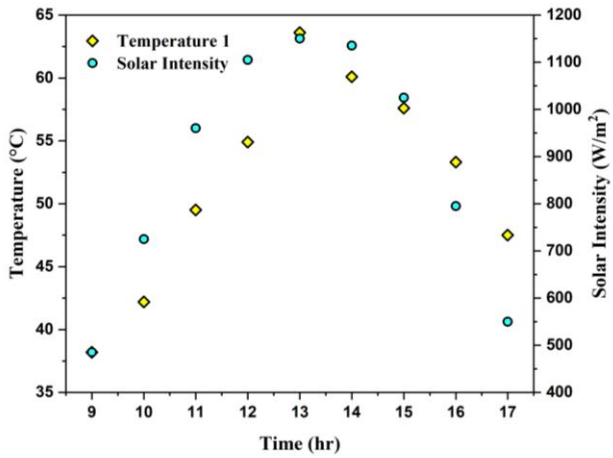

Fig. 6. Solar intensity and single slope glass cover surface temperatures difference over test day hours (12th of March 2023).

4.3. Temperature differences between the input, basin, and outlet

Fig. 7 displays the input water temperature (T_{input}), the outlet fresh water temperature (T_{outlet}, conventional and T_{outlet}, fiber) and the average seawater temperature at the CSS basin ($T_{average}$, conventional) from both stills. The diagram allows us to deduce the following:

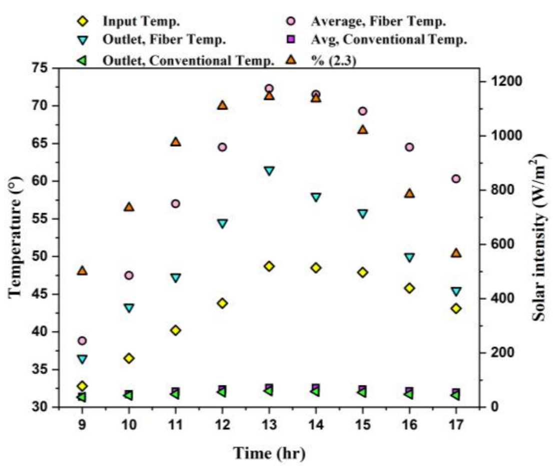

Fig. 7. Variations in daytime solar intensity, average basin temperature, input water, and outgoing desalinized water temperatures (12th of March 2023).

The T_{input} temperature of both stills is equivalent and close to room temperature. Maximum differences in seawater temperature, of roughly 6.4 degrees Celsius, were seen between the still with fibres and the traditional still after midday. The capacity of the used natural fibre to store heat is mostly responsible for this effect. As a result of this pattern of behavior, the water temperature stayed elevated, and evaporation rates raised. Both stills are relatively close to each other (Tout, conv. and Tout, fib.). After noon, the temperature difference was at its greatest (about 3.2 degrees Celsius). The daily variation in sun intensity has a significant effect on all temperatures.

4.4. Distilled water productivity variation

The yield of distilled water by the hour and by the day are shown in Fig. 8 and 9, respectively. During the day, when irradiation levels are maximum (as illustrated in Fig. 8), the stills attain their highest evaporation rate, resulting in their highest hourly production. In terms of hourly output, the still using natural fibre achieved a rate that was 45 percent higher than the standard. The capillary nature of the fibres is mostly responsible for this, as it increased the rate of evaporation. The daily cumulative yield of distilled water for fibre stills was 1599.1 g/m^2 higher than that of the conventional type, as illustrated in Fig. 9.

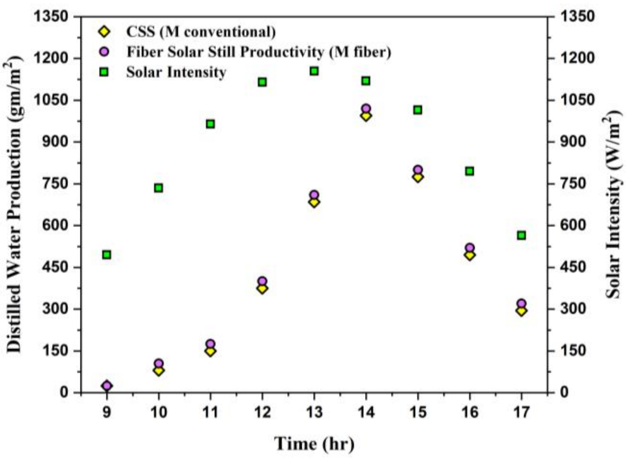

Fig. 8. Differences in solar irradiation and distilled water production during the day (12th of March 2023).

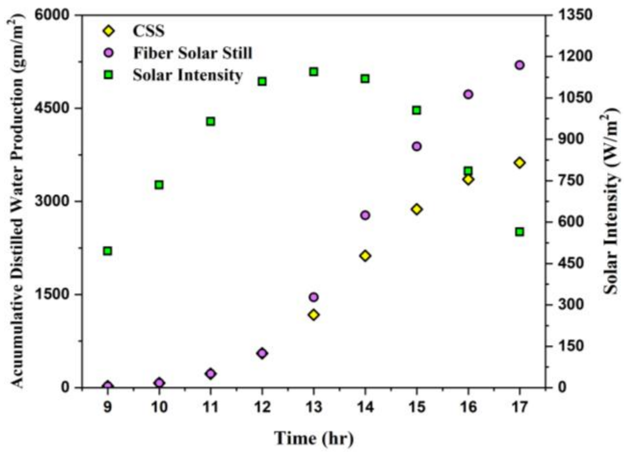

Fig. 9. Test day solar irradiation and accumulated distilled water production (12th of March 2023).

4.5 Absence of solar radiation variation of water production

Table 3 displays the total water productivity that may be obtained from a sealed container between the hours of 5:00 pm and 9:00 am the following morning.

Table 3. Water production for a continuous 16 hours at night (from 5:00 p.m on the 12th of March 2023 to 9:00 a.m. on the 13th of March 2023).

Type	Avg wind speed	Avg ambient temperature	Water productivity
CSS	12 km/hr	22°C	1220 gm/ m^2
SS with natural fibers	12 km/hr	22°C	2470 gm/ m^2

When compared to a traditional still, the production of the SS made with natural fibre was double. The ability of natural fibres to store heat for an extended period of time despite the absence of direct solar irradiation and their impacts on water evaporation, especially at night, are likely responsible for this improvement. Table 4 displays the total water productivity gathered in an enclosed container on an overcast day between the hours of 9:00 am and 5:00 pm. Solar stills made with natural fibres have been found to be more productive than traditional stills. This is because natural fibres have the capacity to store heat and can enhance their evaporation rate when there is no solar present.

Table 4. Cloudy day water productivity (9:00 a.m. – 5:00 p.m).

Type	Average wind speed	Average ambient temperature	Water productivity
CSS	14 km/hr	29°C	870 gm/m^2
SS with natural fibers	14 km/hr	29°C	1350 gm/m^2

4.6. Exergy efficiencies and thermal energy

The exergy efficiency and thermal energy output of the two solar stills are shown hourly in Figure 10. It was shown that the exergy efficiency and thermal efficiency of using the sun as a fuel source are proportional to the sun's intensity. Compared to a CSS, the one with fibres produces more water per unit of thermal energy because the fibres boost water productivity by slowing the rate at which saltwater evaporates inside the basin [29]. The conventional solar still only managed an efficiency of 62 % and an exergy efficiency of 6.7 % during peak solar intensity, while the solar still with fibres managed 82.5 % and 7.6 %, respectively.

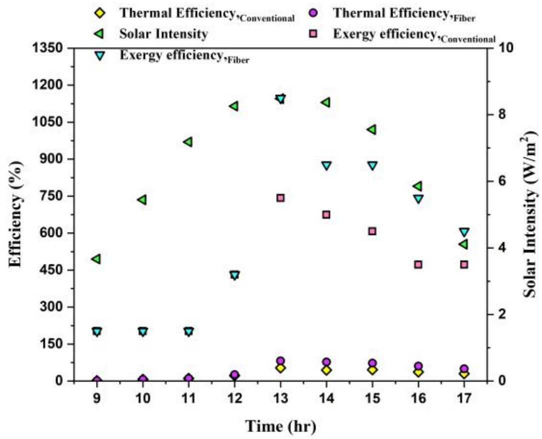

Fig. 10. Variation in solar intensity and thermal and exergy efficiency during the day of testing (12^{th} of March 2023).

Solar still with fibres achieved daily thermal and exergy efficiency of 46.8 % and 5 %. While conventional solar still only managed 31 % and conventional wind only 3.2 %. Exergy efficiency ratings are low because the system is irreversible (exergy is destroyed).

4.7. Cost analysis results

The two designs of SS were compared economically in terms of the cost for creating one unit of fresh water. Because of their similar configuration, construction, and design, the total costs of all parts and characteristics are the same for both solar stills, as shown in Table 5.

Table 5. Single slope SS parameters price.

Parameter	**Price [ ]**
Galvanized steel SS basin (100 × 100 × 10 cm) with a thickness of 0.5 mm	10,663
A variety of valves, pipes, and plumbing equipment	3,691
Black paint	4,101
Wooden box (105×105×10 cm)	5,742
single slope steel structure	11,073
Polyurethane foam (Insulation foam)	5332
Thickness of 4 millimeters, triangular glass (4 sides)	10,253
Labor	16,815
Strips of flat rubber	3,281
Total Principal Cost (Total price)	70,951

Table 6. Price per unit of freshwater output [ ].

	SS with natural fibers	CSS
Total price [ ]		70,951
Life time [year]		10
Interest rate [%]		10
Capital recovery factor		0.16
First annual cost, [ ]		11,354
Salvage value of the still, [ ]		7,096
Sinking fund factor		0.0627
Annual salvage value, [ ]		445
System annual cost, [ ]		12,612
Maintenance cost, [ ]		1,703
The cost of freshwater production per liter [/L]	6.64	9.68
Annual accumulative distilled water [L/ m^2]	1883.7	1303.4

Table 6 details the expenses of both solar still types based on various assumptions about interest rates, salvage values, still lifetimes, and maintenance percentages. A solar still made from natural fibres may produce one liter of fresh water for roughly 6.64, a substantial savings over the cost of water from a CSS (9.68).

5. Conclusions

Natural fibres (coconut leaf sheath) were examined within the basin of a quadrilateral single slope SS for their capacity to improve the supply of drinking water. The technology received exhaustive testing in arid regions. The effectiveness of natural fibre solar stills was measured against that of conventional solar stills. We compared the two systems by calculating their energy and exergy costs. The following can be stated about the systems that have been examined: The single slope shape of the solar still's glass cover was chosen because it maximizes solar radiation reaching the water's surface, speeding up the evaporation process. This layout also features low-temperature glass surfaces, which improve vapor condensation and yield substantial amounts of fresh water both hourly and daily. Solar stills made with natural fibres are more productive than traditional stills. At 2:00, productivity increased by 46 %, making that hour the most productive of the day. Daily productivity increased by 46.5 %. When the sun isn't shining, evaporation rates and freshwater productivity are both negatively impacted by the storage of thermal energy in high-concentration seawater and natural fibres. The thermal energy and exergy efficiency of both systems was measured on an hourly and daily basis. The solar still with fibres has a greater daily thermal energy efficiency of 46.8 % compared to the traditional still's efficiency of 31.6 %. The daily exergy efficiency values of 5 and 3.2 percent show a consistent pattern. The cost analysis showed that compared to a solar still made out of natural fibre, a conventional solar still was 31 % more expensive when producing the same amount of freshwater. This discovery suggests that a solar still made of natural fibres can be used to produce potable freshwater at a cost that is competitive with that of a conventional still and preferable to the cost of delivering freshwater to evaporate in remote areas.

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