Applied Chemical Engineering (2025) Volume 8 Issue 4 ISSN: 2578-2010 (O)
doi: 10.59429/ace.v8i4.5556

ORIGINAL RESEARCH ARTICLE

Various active methods to augment the yield of solar still: A mini review

Choon Kit Chan[1*], Rajashree Bokhare[2], Gaurav kumar[3], Richa Rani[4], Sandeep Kumar[5], Ghanshyam G Tejani[6,7], Feroz Shaik[8], Sujeet Kumar[9,10], Roshan Singh[11,12]

[1] *Faculty of Engineering and Quantity Surveying, INTI International University, Putra Nilai, Negeri Sembilan, 71800 ,Malaysia*

[2] *Department of Mechanical Engineering, Dr D Y patil Institute of engineering and Technology, Pune, 411001,India*

[3] *Research and Innovation Cell, Bahra University, Distt. Solan, HP, Waknaghat, 173234,India*

[4] *Department of Mechanical Engineering, Rayat Bahra Institute of Engineering and Nano Technology, Hoshiarpur, Punjab, 146001, India*

[5] *Research and Innovation Cell, Rayat Bahra University, Mohali, Punjab, 140301, India*

[6] *Applied Science Research Center. Applied Science Private University, Amman, 11937, Jordan*

[7] *Jadara University Research Center, Jadara University, 21110, Jordan*

[8] *Department of Mechanical Engineering, Prince Mohammad Bin Fahd University, 31952, Kingdom of Saudi Arabia*

[9] *Division of research and development, Lovely Professional University, Phagwara, Punjab, 146001, India*

[10] *Centre for Promotion of Research, Graphic Era (Deemed to be University), Uttarakhand, Dehradun, 248199, India*

[11] *Centre of Research Impact and Outcome, Chitkara University, Rajpura , Punjab, 140417, India*

[12] *Division of Research & innovation, Uttaranchal University, Dehradun, 248007,India*

***Corresponding author:** Choon kit Chan ; choonkit.chan@newinti.edu.my

ABSTRACT

Solar still (SS) is a cheap and easy method for producing pure water from saline or brackish water. Therefore, the SS is not a popular residential water supply. The present review shows various active methods for SS coupled with a flat plate collector (FPC), evacuated tubes (ET), and parabolic trough (PT) to augment the yield. It also shows that a table of various researchers works to enhance the yield owing to the hot water supply to the basin. Active methods using SS are effective in improving yield. Finally, future work on different active methods should be conducted for further research on SS.

Keywords: Solar still (SS); Evacuated tubes (ET); Flat plate collector (FPC); Parabolic trough (PT), Energy efficiency

ARTICLE INFO

Received: 10 October 2025
Accepted: 31 October 2025
Available online: 11 November 2025

1. Introduction

Freshwater needs are increasing daily because of rapid population and business growth [1]. A primary concern is potential water shortages. Human and animal life relies on the availability of freshwater [2]. Adequate measures are required to ensure the current supply of fresh water. To meet rising freshwater needs, saline water must be converted into pure water. Solar desalination can solve this problem owing to its numerous techniques and processes [3-4]. However, these methods require many fossil fuels and their availability is low worldwide. Solar stills (SS) can be used to desalinate solar energy, but are not used for potable water applications because of their lower yield [5].

Higher water temperatures in the basin improve yield ; therefore, researchers have used solar collectors coupled with SS. Subramanian et al. [6] used a flat plate collector (FPC) and found a 60% increase in heating efficiency owing to the extra water temperature entering the basin. Hossein Amiri et al. [7] used SS with an inbuilt parabolic trough (PT) collector to enhance the yield and conducted several experiments at Kerman. Their experimental investigations found 0.961 L and 30% higher yields than those of conventional SS. Narayana and Raju [8] performed an experimental analysis of an SS with parallel connections of the FPCs. They also determined the number of collectors per distillate yield of SS. They found that parallel connection of the FPCs increased the yield but reduced the efficiency of the SS. Vishal et al. [9] predicted the performance of an SS by using an evacuated-tube collector. They used experimental data and mathematical modelling to produce good agreement. Venkatsamy et al. [10] used baffle plates in an inclined-type SS and tested the climatic conditions in Tamil Nadu, India. They measured various temperatures, yields, and solar intensities every hour during experimental days and obtained a 3.50 kg/m2 yield from SS. Panchal et al. [11] reviewed various techniques applied to SS to improve its performance in terms of the yield. Shukla et al. [12] conducted a parametric study of SS and SS with a collector based on modified relations of convective mass transfer. Mevada et al. [13] reviewed various applications of ETC in solar energy applications. They studied the use of ETC in desalination, cooking, water heating, etc. Shinde et al. [14] reviewed various types of SS and compared them according to their yields. They also discussed the working principles and methods for improving yield. Abdullah et al. [15] reviewed various studies and developments in Wick-type SS. They discussed the mechanism to increase the yield in Wick-type SS based on capillary actions and explained various studies in detail. Patel et al. [16] reviewed the SS based on past, present, and future research. They explained the work done by researchers in detail from past and current perspectives.

Finally, they added future research investigations on SS to enhance the yield. Karthik et al. [17] improved SS yield during a low-intensity period by applying vacuum pressure. They concluded that a vacuum pressure of 0.6 bar maintained in SS was used to enhance the yield by 30%. Iqbal et al. [18] fabricated a hybrid solar still and coupled it with a solar heater to improve its evaporation rate and yield. They understood the scientific method of water evaporation very well, which changed their work to the coating of SS. Shyora et al. [19] performed a comparative analysis of stepped and conventional SS under the climatic conditions of Gandhinagar and Gujarat. They performed several tests and conducted a comparative study based on the yield. They obtained a 23.88% enhancement in yield using Stepped SS compared to conventional SS. Shinde et al. [20] compared the amended design of SS with a conventional design in terms of yield. They found that the amended SS design improved the yield by 17% compared with the conventional design. Ganaraj et al. [21] enhanced the yield of double-slope SS using internal and external modifications. Internal modifications involve the use of storage materials and external modifications involve the use of fixed mirrors. They found that these changes improved the SS yield by 40.86%. Shanmugan et al. [22] conducted a performance analysis of an SS based on energy and exercise. They prepared a computer program to evaluate various equations for measuring the energy and exergy of an SS.

The SS is regarded as one of the simplest and most affordable desalination devices. Researchers worldwide have attempted to improve this output. The main objective of this review is to examine different SS researchers, namely SS with a flat plate collector (FPE), SS with evacuated tubes (ET), and SS with a parabolic trough collector (PT).

2. Solar still with Flat plate collector (FPC)

FPC is considered one of the most widely used solar collectors for water-heating purposes. It is comprised of a flat-plate box-type basin with a glass cover and tubing for water movement.

Badran et al. [23] compared the performance of an SS with and without an FPC. They performed a performance analysis using tap water as the feed water for 24 h at a time interval. They used a constant-head tank to provide a continuous water supply to the SS to maintain constant water. They concluded that the use of FPC with SS improved by 231% compared with SS alone. Figure 1. shows a schematic of the SS with an FPC and a constant heat tank.

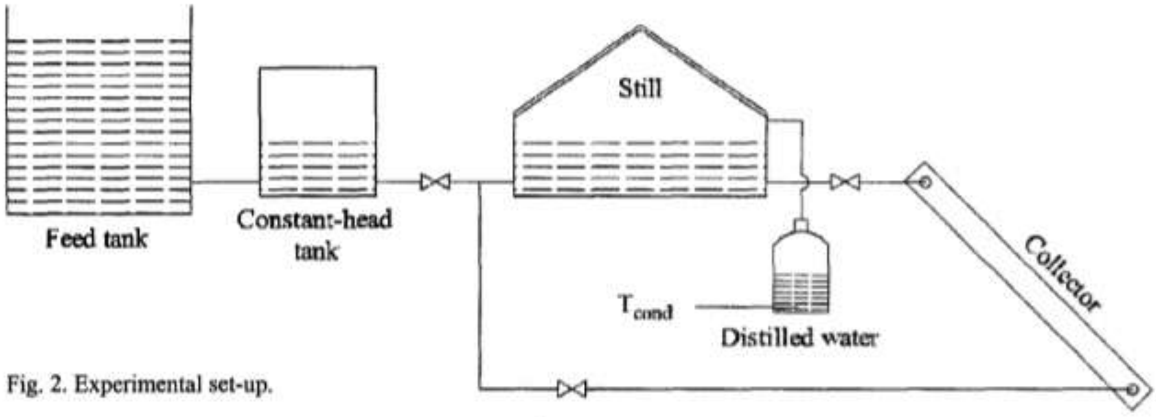

Figure 1. Schematic diagram of SS with FPC and constant heat tank [23]

Badran and Tahaineh [24] conducted a similar experiment on an FPC with an SS. However, they used other parameters, such as water depth, intensity, and direction. They even fixed the mirrors at the inner side of the sidewalls to reflect the sun rays towards the water and enhance the yield. They found a 36% enhancement in yield by coupling FPC with SS compared to SS alone. They also concluded that the solar intensity incident on the SS is directly proportional to the yield.

Rajaseenivasan et al. [25] conducted an interesting study on integrated FPC in SS to enhance the yield. They prepared an experimental setup such that two separate compartments were seen in the experimental setup. Because of the separate compartment, the water was preheated and then entered the SS basin; the yield increased compared to SS alone. They compared the performances at various depths of water, wick materials, and storage materials. They concluded that the integrated FPC in the SS was 60% higher than that of the SS alone. Figure 2. shows a schematic of the integrated FPC with an SS.

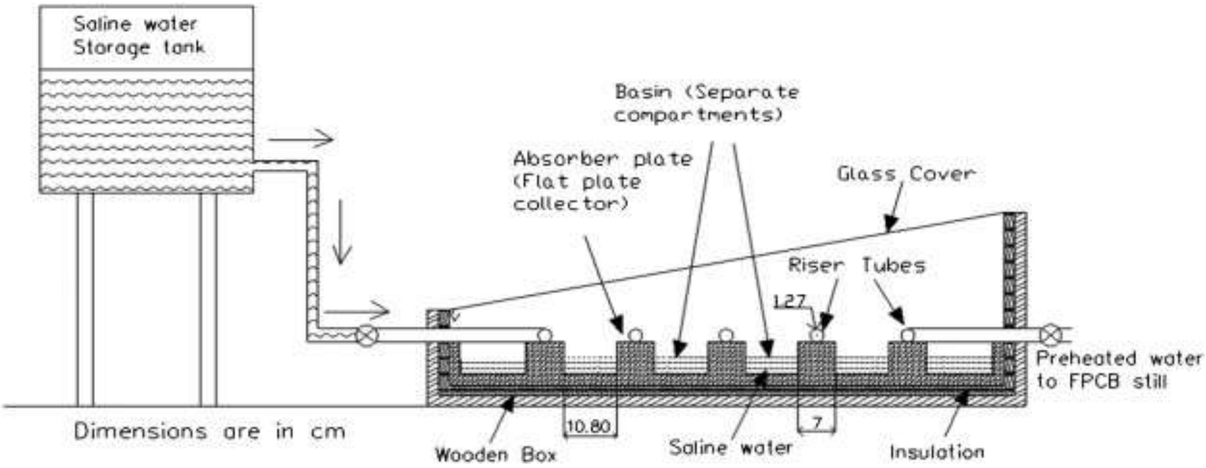

Figure 2. Schematic diagram of integrated FPC with SS [25]

Raju and Narayana [26] conducted an experimental investigation on a three-series coupled FPC with an SS. Their main aim was to determine their effects on the yield and efficiency. They used three similar-sized FPCs with a cross-sectional area and 30-degree inclination of the glass cover with an SS. The series connection of the FPC yielded 89 percent more than a single-phase SS owing to the supply of hot water within the basin of the SS. A maximum of 5.04 kilogrammes of potable water was obtained from each solar collector. Figure 3. shows a schematic of the SS series connected to three similar FPCs.

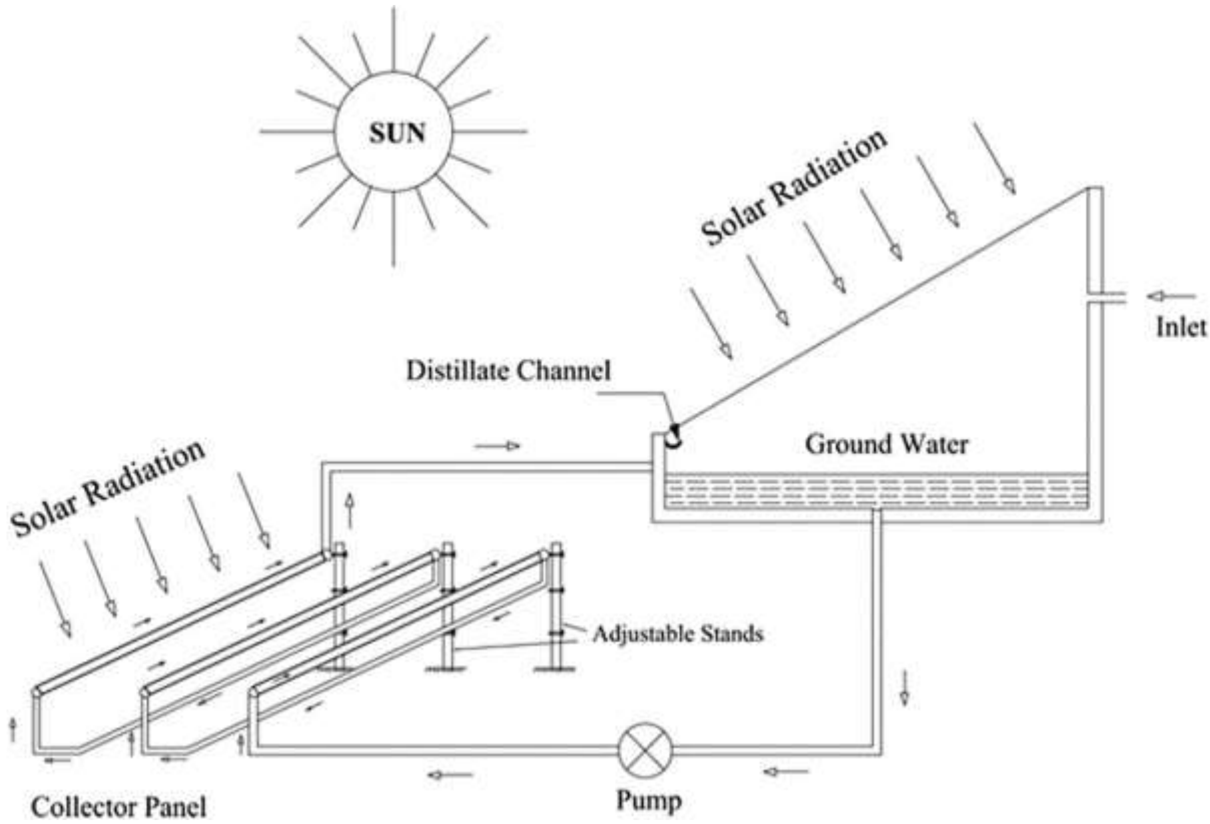

Figure 3. Schematic diagram of SS coupled with three same-sized FPCs under series connection [26]

Etawil and Omara [27] used a photovoltaic panel, FPC, and hot-air injection with SS to enhance yield. The main objective of this study was to make SS that can be used in remote locations to provide electricity and potable water. They performed several readings with hot-air injection, photovoltaic panels, and with and without a flat-plate collector to check their performance. They found that hot-air injection is an excellent method for enhancing the yield of FPC and solar photovoltaic panels.

Morad et al. [28] performed an experimental analysis of FPC-coupled SS with and without glass-cover cooling. They primarily aimed to increase the yield by using hot water from the FPC and cooling the cover. They conducted several experiments in Egypt on SS coupled with glass-cover cooling. They concluded that a 10 L glass flask yield with FPC was obtained.

Kumar et al. [29] investigated the performance of a double-slope solar still (DSSS) with and without an FPC. Results show a 74% increase in water yield, reaching 3020 mL/day and 633 mL/hr; energy efficiency (0.13 mL/kJ) increases by 18% from experimental work in Thalassery, India. However, shadowing on the FPC lowers the efficiency; this is handled using artificial neural network (ANN) modeling to maximize solar energy absorption and improve SS performance.

The performance of a modified double basin solar still (MDBS) with external reflectors, a bottom basin integrated with a FPC and a small solar pond is investigated by Muthukumar, Rajesh and Ganaraj [30]. The results show a yield increase of 5,650 mL/m²·day using external reflectors at Francis Xavier Engineering College, Tirunelveli, India. It was found that, over 20 days, the yield was 6,249 mL/m²·d when paired with FPC, and solar ponds improved efficiency and yield by 127.5%.

Energy measurements for N in both PVT FPC integrated with a single-slope solar still (N-PVTFPCSS) at a constant water depth were investigated by Sharma et al. [31]. In line with the Sustainable Development Goals of the United Nations, system performance for sustainable SS should be optimized. MATLAB-2015 was used to compute the energy metrics under four climate scenarios in New Delhi over a year. Results show that energy payback time rises with increasing $\dot{m}f$ up to 0.10 kg/s; beyond that it stabilizes. From an exergy perspective, the ideal N for energy efficiency was 8.

A Conventional solar still (CSS), horizontal wick solar still (HWSS) with a flat plate collector (FPC), and basin-tilted wick solar still at 30° integrated with an FPC were investigated experimentally by Negi et al. [32]. Two scenarios were investigated: tilted wick SS with FPC compared to HWSS (Case-2) and HWSS with FPC compared to CSS (Case-1.). The results show that the HWSS and CSS generated 2.894 kg/m²-day and 3.216 kg/m²-day of yield, respectively.

3. Solar still with Evacuated tubes

Evacuated tubes (ETC) are solar thermal devices used for heating. They work primarily on the thermosyphon effect; therefore, unlike flat-plate collectors, they do not require a water supply pump.

Shafi et al. [33] used SS coupled with ET and thermo–electric modules. Their main intention was to enhance the SS yield and water condensation. The power produced by the thermo–electric modules was utilized to run the fan in the SS to enhance the forced convection of air. In their experimental results, they received a maximum yield of 1.11 kg/m^2 h with 68 percent efficiency.

Singh et al. [34] used modelling and validation techniques to study SS and ET using the natural circulation model. In their experimental research in India, the water depth varied with time. This system can measure productivity (yield, energy, and exercise) using a practical setup. They concluded that the basin's 0.03 m water depth found an optimum of 3.8 kg/m^2.

Kumar et al. [35] studied the performance of a system with ET in forced circulation mode. Thermal analysis was also performed, and the results were compared with the experimental results. The experiments were performed at different flow rates and depths in the SS basin. They concluded that the mass flow rate of 0.06 kg/s and the water depth of 0.03 m for the yield of SS with ET were optimal. Finally, they concluded that the SS yield with ET was higher in the forced circulation model than that in the natural circulation mode.

Singh and Tiwari [36] conducted modelling and analyzed N-identical ET under climatic conditions in New Delhi, India. They used single and double slopes for the experimental and theoretical analyses. The ET collectors were optimized to maximize the mass flow rate of the water. Good theoretical and experimental results were obtained. The system has also been used for commercial potable-water applications. **Figure 4** shows a schematic diagram of N-ETC-DS.

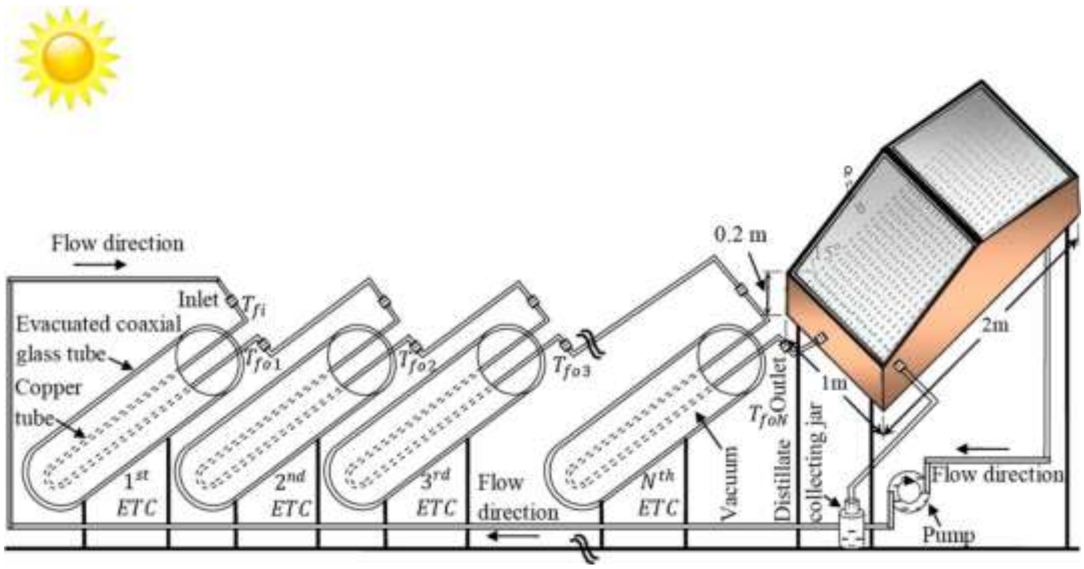

Figure 4. Schematic diagram of N-ETC-DS

Abdullah et al. reviewed the integration of ETC technology with various SS to improve the evaporation process in relation to minimizing carbon emissions, economic viability, and environmental impact [37]. They examined numerous evacuated tube heater designs, including parabolic collector-based, tank-based, and direct natural mode connections. Appropriate integration significantly boosts yield (20.95 L/m²), energy efficiency (65.48%), and exergy efficiency (6.67%), over SS by 431.7%, 57.82%, and 74.61%, respectively. Moreover, a bibliometric analysis using VOSviewer highlights advancements in solar collector-based desalination systems that are also under investigation.

For the storage of 100 Litre saline water, Alshqirate et al. [38] studied the performance of a semi-cylindrical SS integrated with ETCs. Two different glass surfaces with different temperatures helped improve condensation by a tent-shaped glass cover. The method proved to be more efficient because it produced 9.7 a of daily yield, the maximum possible. The vacuum tubes greatly improved the thermal performance, thereby producing an exergy efficiency of 5.7% and an overall thermal efficiency of 30.9%. **Figure 5** shows a schematic of a semi-cylindrical tent-shaped SS coupled with an ETC.

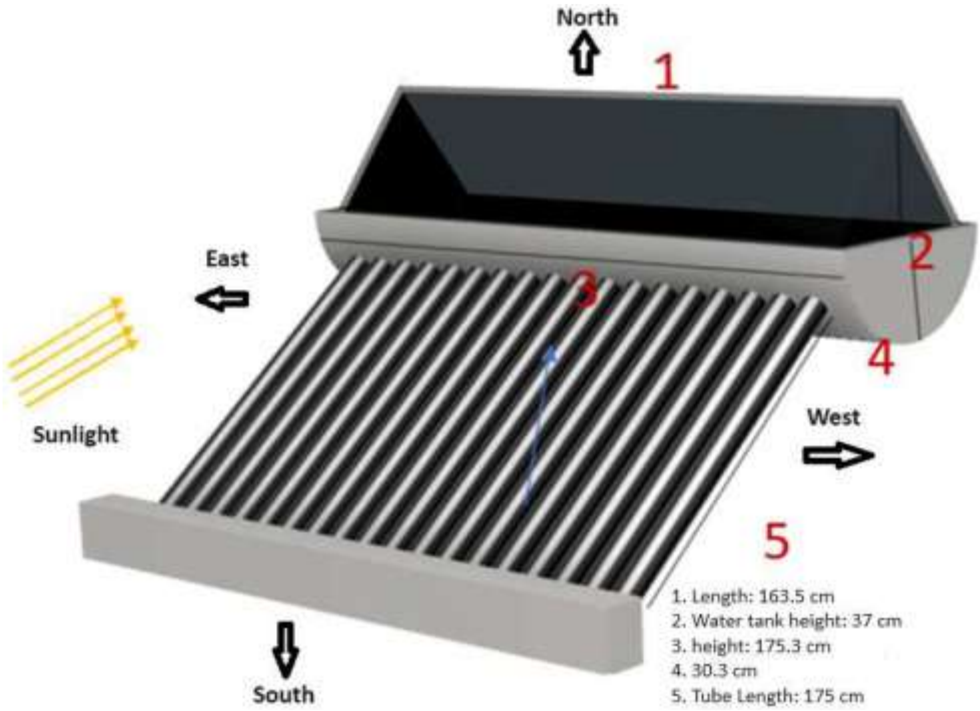

Figure 5. Schematic diagram of Semi-cylindrical tent shape SS coupled with ETC [38]

Pathak et al. [39] aimed to improve the energy and exergy performance by integrating an SS with a stearic acid-based ETC. They found that the second law efficiency increased by 24.9% to 36.2%, and the system greatly increased the energy efficiency, ranging from 35.9% to 52.2%. The effective heat storage and transfer characteristics of stearic acid provide these improvements, thereby enhancing the evaporation-condensation process. Furthermore, confirming the economic feasibility, the cost analysis shows that the unit cost of potable water production ranges from \$0.004/L to \$0.33/L.

Hemmatian et al. [40] assessed heat pipes (HP), Heat Pipe evacuated tubes (HPETC), and phase change material (PCM)-enhanced solar stills. These methods maximize thermal efficiency and yield through the best heat retention and transfer. Furthermore, we evaluated the environmental impact by comparing several SS designs CO_2, SO_2, and NO emission reductions. With a water production of 2248 mL/m², the cost per liter (CPL) of potable water for the SSHP-PCM-2 system was \$0.0458/L. These results highlight the environmental and financial advantages of including cutting-edge heat management systems for solar desalination.

4. Solar still with parabolic trough collector

The parabolic trough (PT) collector is a mature technology for concentrating collectors used in solar thermal applications. It is a line-focusing concentrator that provides higher water temperature.

Fathy et al. [41] conducted an experimental analysis of SS and PT under Egyptian climatic conditions. They used a double-slope SS in their experimental study with tracked and fixed modes. They compared the performance with and without a tracked PT collector during summer and winter with the SS alone. They concluded that the yield and efficiency of the tracked PT with SS were higher than those without SS. **Figure 6** shows the experimental setup of the SS coupled with PTC.

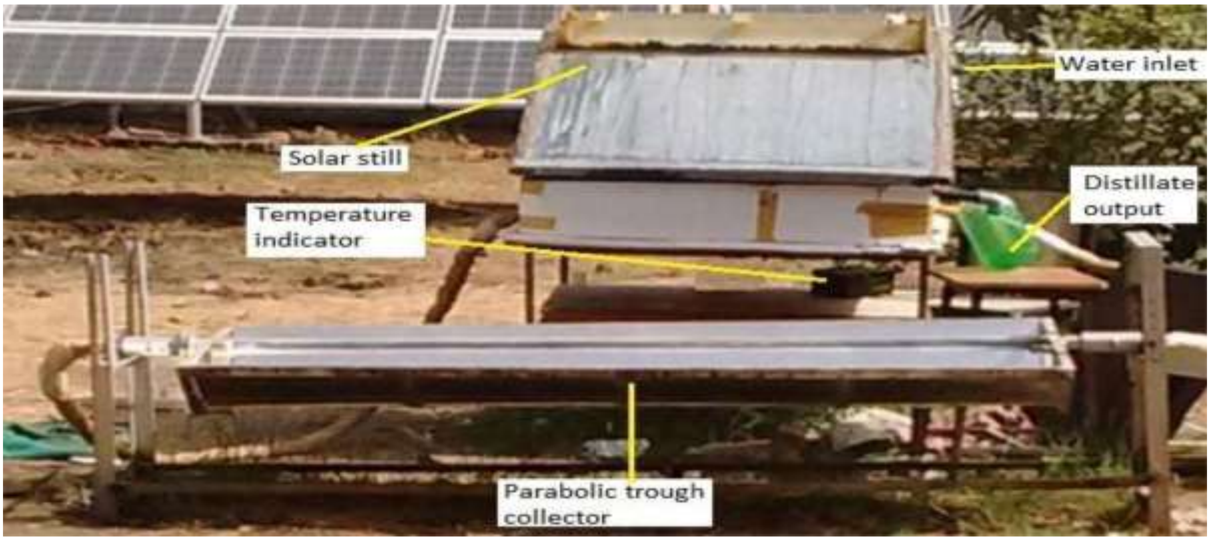

Figure 6. Experimental setup of SS with PTC [39]

Hasan et al. [42] compared the performance of SS alone and modified SS in Egypt's climate conditions. They used tracked PT with SS as a modified SS and compared it with SS alone. They used the saline water medium and basin materials as variables to compare the modified and SS alone. Wire mesh and sand were used as the basin materials in the SS. Their experimental work showed that wire mesh and sand enhanced the yield of SS in both cases. The modified case increased by 14% and 3% with the use of basin materials alone, respectively.

Madiouli et al. [43] used a packed-bed system coupled with SS, FPC, and PT. They used separate connections for both cases, using a heat exchanger. They conducted experiments under summer and winter climatic conditions to obtain accurate results. They found that the combination of FPC, PT, and packed bed with SS resulted in a higher yield than SS alone owing to the hot water supply. **Table 1** lists the various active methods used to enhance SS yield.

Table 1. compares various active methods for enhancing the yield of SS using FPC, ET, and PT.

Author(s)	Work Done	Outcome
Badran et al. [23]	Compared solar still (SS) performance with and without a flat plate collector (FPC) using a constant head tank.	Using FPC improved SS yield by **231%** compared to SS alone.
Badran & Tahaineh [24]	Investigated SS with FPC and additional parameters like water depth, solar intensity, and mirrors for reflection.	Yield increased by **36%**, and solar intensity was directly proportional to yield.
Rajaseenivasan et al. [25]	Integrated FPC in SS with separate compartments to preheat water before entering the SS basin.	Integrated system improved yield by **60%** compared to SS alone.

Author(s)	Work Done	Outcome
Raju & Narayana [26]	Investigated SS with three-series-coupled FPCs at different inclinations.	Series connection yielded **89%** more than a single SS, with **5.04 kg/day** of potable water per collector.
Etawil & Omara [27]	Combined SS with FPC, photovoltaic panel, and hot air injection.	Hot air injection significantly improved yield and performance of the SS system.
Morad et al. [28]	Experimented with FPC-coupled SS with and without glass cover cooling in Egypt.	Found improved yield when using **glass-cover cooling**, achieving **10 L/day**.
Sivakumar et al. [29]	Analyzed double slope solar still (DSSS) with and without FPC.	Water yield increased by **74%** (3020 mL/day), with **18% higher energy efficiency**.
Muthukumar et al. [30]	Studied modified double basin SS with external reflectors, an FPC-integrated bottom basin, and a small solar pond.	Yield improved to **5,650 mL/m²·day**, with an overall **127.5% increase**.
Gaurav Kumar Sharma et al. [31]	Investigated PVT-FPCSS under four climate scenarios using MATLAB.	Energy efficiency optimized at **ṁf = 0.10 kg/s**, and the ideal **N for exergy efficiency was 8**.
Negi, Dhindsa & Sehgal [32]	Compared HWSS with FPC and conventional SS under different conditions.	HWSS and CSS generated **2.894 kg/m²-day** and **3.216 kg/m²-day** yields, respectively.
Shafi et al. [33]	Used SS coupled with evacuated tubes (ET) and thermoelectric modules.	Achieved **1.11 kg/m²h** yield with **68% efficiency**.
Singh et al. [34]	Modeled SS with ET under natural circulation in India.	Found **3.8 kg/m²** yield with an optimal **water depth of 0.03 m**.
Kumar et al. [35]	Studied SS with ET under forced circulation.	Optimal **mass flow rate of 0.06 kg/s** and **0.03 m water depth** improved yield.
Singh & Tiwari [36]	Modeled and analyzed N-identical ET under different slope angles in New Delhi.	Optimized **mass flow rate of water** for maximum yield.
Abdullah et al. [37]	Reviewed ETC integration with SS for efficiency and environmental impact.	Yield **increased by 431.7%** (20.95 L/m²), **energy efficiency reached 65.48%**, and **exergy efficiency 6.67%**.
Alshqirate et al. [38]	Studied semi-cylindrical SS integrated with ETC for 100 L storage.	Maximum daily yield of **9.7 L/day**, with **30.9% thermal efficiency** and **5.7% exergy efficiency**.
Pathak et al. [39]	Investigated SS with stearic acid-based ETC.	Improved **second-law efficiency (24.9–36.2%)** and **energy efficiency (35.9–52.2%)**. Cost per liter ranged from **$0.004/L to $0.33/L**.
Hemmatian et al. [40]	Analyzed HP, HPETC, and PCM-based SS for environmental impact.	SSHP-PCM-2 produced **2248 mL/m²**, and CPL was **$0.0458/L**.
Fathy et al. [41]	Investigated SS with PT in Egypt with tracked and fixed modes.	Tracked PT improved SS yield and efficiency compared to non-tracked systems.
Hasan et al. [42]	Compared SS alone with modified SS using tracked PT.	Modified SS improved yield by **14% (wire mesh)** and **3% (sand basin material)**.
Madiouli et al. [43]	Used packed-bed SS coupled with FPC and PT with a heat exchanger.	Combined system achieved **higher yield** than SS alone due to hot water supply.

Table 1. (*Continued*)

5. Discussion on SS with FPC, ETC and PT

Table 1 lists several solar still (SS) augmentation methods using flat plate collectors (FPC), evacuated tube collectors (ETC), parabolic trough collectors (PT), and phase change materials (PCM). The results show that including these technologies greatly increases yield.

Research on flat plate collectors (FPC) has been extensive; when combined with SS, they exhibit significant yield gains. Depending on other variables such as water depth, solar intensity, and mirror reflectors,

performance improvements ranged from 36% to 231%. Studies showing an 89% yield boost using series-coupled FPCs even improves efficiency. FPCs combined with photovoltaic panels, hot air injection, and outside reflectors further increase the output.
With productivity increases often surpassing 400%, evacuated tube collectors (ETC) have demonstrated exceptional thermal efficiency. Including ETCs with SS not only increases the water output, but also increases the exergy efficiency and thermal performance. Certain configurations have paired ETCs with phase change materials to maximize heat retention and storage, thus producing greater efficiency and economic viability.

In particular, when coupled with tracking systems, parabolic trough collectors (PT) offer further increases in efficiency. Studies have found that tracked PT systems maximize the solar energy absorption by far outperforming stationary configurations. Furthermore, thermal management and water yield can be improved by including packed-bed systems and heat exchangers with PT and FPC.

The integration of available solar thermal technologies with SS generally results in notable performance enhancement. Although these techniques improve the yield and efficiency, more studies are required on cost-effective, scalable, and long-term operational viability to maximize useful applications.

6. Conclusion

From this paper, the following points are concluded:

- The addition of a hot water heater to the FPC increased the yield and required less heat for evaporation.
- The use of a mirror at the side of the basin in the SS with FPC increased the yield by reflecting rays.
- The integration of FPC with SS increased the yield because of the preheated water supply to the basin.
- FPC with SS and glass cover cooling is an effective method for enhancing yield.
- ET with SS increased the yield by supplying hot water, and unlike FPC, it did not require a pump.
- The forced circulation method was more useful than the natural circulation method for SS with ET.
- ET with SS effectively provides potable water for commercial purposes when several systems are used.
- The SS with a tracked PT collector provided a higher yield than that with a fixed PT collector.

7. Future Work

From this review article, the following points have emerged for researchers to carry out further work:

- Use of the SS with PT and condenser has not used by the researchers.
- SS with PT, condensers, and various sensible and latent heat storage materials can enhance yield.
- The use of SS with PT, a condenser, and a packed bed is also an effective method for enhancing the yield.

Conflict of interest

The authors declare no conflict of interest

References

1. Panchal, H., Patel, N., & Thakkar, H. (2015). Various techniques for improvement in distillate output from active solar still: A review. International Journal of Ambient Energy, 38(2), 209–222. https://doi.org/10.1080/01430750.2015.1076518

2. Natarajan, E., Ramasamy, G., Abdullah, H., Sekar, S. M., & Abd Hamid, A. R. (2025). Emerging contaminants in water: An overview of causes, metrics, and treatment methods. In Sustainable Structural Materials: From Fundamentals to Manufacturing, Properties and Applications. UCSI University.pp. 241 – 255.
3. Panchal, H. N. (2016). Life cycle cost analysis of a double-effect solar still. International Journal of Ambient Energy, 38(4), 395–399. https://doi.org/10.1080/01430750.2015.1132767
4. Ghandourah, E., Panchal, H., Fallatah, O., Ahmed, H. M., Moustafa, E. B., & Elsheikh, A. H. (2022). Performance enhancement and economic analysis of pyramid solar still with corrugated absorber plate and conventional solar still: A case study. Case Studies in Thermal Engineering, 35, 101966. https://doi.org/10.1016/j.csite.2022.101966
5. Panchal, H., & Awasthi, A. (2017). Theoretical modeling and experimental analysis of solar still integrated with evacuated tubes. Heat Mass Transfer, 53, 1943–1955. https://doi.org/10.1007/s00231-016-1953-8
6. Subramanian, R. S., Kumaresan, G., Ajith, R., Sabarivasan, U., Gowthamaan, K. K., & Anudeep, S. (2020). Performance analysis of modified solar still integrated with flat plate collector. Materials Today: Proceedings. https://doi.org/10.1016/j.matpr.2020.06.409
7. Amiri, H., Aminy, M., Lotfi, M., & Jafarbeglo, B. (2021). Energy and exergy analysis of a new solar still composed of parabolic trough collector with built-in solar still. Renewable Energy, 163, 465–479.
8. Narayana, R. L., & Raju, V. R. (2019). Experimental investigation of a passive solar still with and without tetrahedral sponge in basin. International Journal of Ambient Energy, 40(3), 285–291.
9. Bhalla, V., Beejawat, S., Doshi, J., Khullar, V., Singh, H., & Tyagi, H. (2020). Silicone oil envelope for enhancing the performance of nanofluid-based direct absorption solar collectors. Renewable Energy, 145, 2733–2740.
10. Venkatasamy, M., Sivamani, S., Venkatesan, H., & Thangaraj, M. (2018). Experimental study on productivity enhancement of an improvised inclined solar still. International Journal of Ambient Energy, 39(2), 165–175.
11. Panchal, H., Patel, D. K., & Patel, P. (2018). Theoretical and experimental performance analysis of sandstones and marble pieces as thermal energy storage materials inside solar stills. International Journal of Ambient Energy, 39(3), 221–229.
12. Shukla, S. K., & Sorayan, V. P. S. (2005). Thermal modeling of solar stills: An experimental validation. Renewable Energy, 30(5), 683–699.
13. Mevada, D., Panchal, H., ElDinBastawissi, H. A., Elkelawy, M., Sadashivuni, K., Ponnamma, D., & Sharshir, S. W. (2019). Applications of evacuated tubes collector to harness solar energy: A review. International Journal of Ambient Energy, 43(1), 344–361. https://doi.org/10.1080/01430750.2019.1636886
14. Shinde, M., Navthar, R., & Shinde, S. M. (2020). Review on the types of solar stills. International Journal of Ambient Energy, 43(1), 1420–1428. https://doi.org/10.1080/01430750.2019.1707114
15. Abdullah, A. S., Essa, F. A., & Omara, Z. M. (2019). Effect of different wick materials on solar still performance: A review. International Journal of Ambient Energy. https://doi.org/10.1080/01430750.2018.1563808
16. Patel, M., Patel, C., & Panchal, H. (2019). Past, present, and future of the active solar distillation system: A comprehensive review. International Journal of Ambient Energy. https://doi.org/10.1080/01430750.2019.1684996
17. Karthik, K., Manimaran, A., Ramesh Kumar, R., & Prakash, J. U. (2020). Solar energy performance analysis of basin-type solar still under the effect of vacuum pressure. International Journal of Ambient Energy, 41(8), 922–926. https://doi.org/10.1080/01430750.2018.1501734
18. Iqbal, S. M., Karthik, K., & Michael, J. J. (2020). Performance analysis on improved efficiency in a hybrid solar still and solar heater. International Journal of Ambient Energy, 41(13), 1516–1523.
19. Shyora, A., Patel, K., & Panchal, H. (2019). Comparative analysis of stepped and single basin solar still in climate conditions of Gandhinagar, Gujarat during winter. International Journal of Ambient Energy. https://doi.org/10.1080/01430750.2019.1612781
20. Shinde, M., Navthar, R., Shinde, S., & Bhojwani, V. (2020). Performance analysis of single slope solar still with improved design. International Journal of Ambient Energy. https://doi.org/10.1080/01430750.2020.1722227
21. Gnanaraj, S. J. P., Ramachandran, S., & Christopher, D. S. (2018). Enhancing the productivity of double-slope single-basin solar still with internal and external modifications. International Journal of Ambient Energy, 39(8), 777–782.
22. Shanmugan, S., Manikandan, V., Shanmugasundaram, K., Janarathanan, B., & Chandrasekaran, J. (2012). Energy and exergy analysis of single slope single basin solar still. International Journal of Ambient Energy, 33(3), 142–151.
23. Badran, A. A., Al-Hallaq, I. A., Salman, I. A. E., & Odat, M. Z. (2005). A solar still augmented with a flat-plate collector. Desalination, 172(3), 227–234.
24. Badran, O. O., & Al-Tahaineh, H. A. (2005). The effect of coupling a flat-plate collector on the solar still productivity. Desalination, 183(1–3), 137–142.
25. Rajaseenivasan, T., Raja, P. N., & Srithar, K. (2004). An experimental investigation on a solar still with an integrated flat plate collector. Desalination, 347, 131–137.
26. Ramachandra Raju, V., & Lalitha Narayana, R. (2018). Effect of flat plate collectors in series on performance of active solar still for Indian coastal climatic condition. Journal of King Saud University - Engineering Sciences, 30(1), 78–85.
27. Eltawil, M. A., & Omara, Z. M. (2014). Enhancing the solar still performance using solar photovoltaic, flat plate collector and hot air. Desalination, 349, 1–9.

28. Morad, M. M., El-Maghawry, H. A. M., & Wasfy, K. I. (2015). Improving the double slope solar still performance by using flat-plate solar collector and cooling glass cover. Desalination, 373, 1–9.
29. Sivakumar, C. K., Robinson, Y., Gnanaraj, J. P., & Jithendra, K. B. (2024). Analysis of the performance of V-type solar stills coupled with flat plate collectors and the potential use of artificial intelligence. Desalination and Water Treatment, 318, 100365. https://doi.org/10.1016/j.dwt.2024.100365
30. Kumar, M. M., Rajesh, S., & Gnanaraj, S. J. P. (2023). Experimental investigation of double basin solar still integrated with solar flat plate collector and solar pond with modified design. Desalination and Water Treatment, 290, 26–35. https://doi.org/10.5004/dwt.2023.29454
31. Sharma, G. K., Mallick, A., Sharma, R. K., Kumar, N., & Singh, D. B. (2023). A comprehensive study on the effect of variation of flow rate of fluid and N on energy metrics of N similar photovoltaic thermal flat plate collectors integrated single slope solar still. Desalination and Water Treatment, 283, 97–108.
32. Negi, A., Dhindsa, G. S., & Sehgal, S. S. (2022). Experimental investigation on single basin tilted wick solar still integrated with flat plate collector. Materials Today: Proceedings, 48(5), 1439–1446. https://doi.org/10.1016/j.matpr.2021.09.210
33. Shafii, M. B., Shahmohamadi, M., Faegh, M., & Sadrhosseini, H. (2016). Examination of a novel solar still equipped with evacuated tube collectors and thermoelectric modules. Desalination, 382, 21–27.
34. Singh, R. V., Kumar, S., Hasan, M. M., & Khan, M. E. (2013). Performance of a solar still integrated with evacuated tube collector in natural mode. Desalination, 318, 25–33.
35. Kumar, S., Dubey, A., & Tiwari, G. N. (2014). A solar still augmented with an evacuated tube collector in forced mode. Desalination, 347, 15–24.
36. Singh, D., & Tiwari, G. (2017). Energy, exergy and cost analyses of N identical evacuated tubular collectors integrated basin type solar stills: A comparative study. Solar Energy, 155, 829–846.
37. Abdullah, A. S., Joseph, A., Abdelaziz, G. B., Edreis, E. M. A., Attia, M. E. H., Alawee, W. H., & Sharshir, S. W. (2024). Harnessing evacuated tube technology for enhanced solar still: A comprehensive review. Results in Engineering, 24, 103335.
38. Alshqirate, A. A., Badran, O., Quran, O., Al-Marahleh, G., Olimat, A. N., Al Alawin, A., Al Shorman, A., & Alahmer, A. (2024). Enhanced distilled water productivity using an innovative semi-cylindrical tent-shaped solar still coupled with evacuated tubes. International Journal of Thermofluids, 24, 100880. https://doi.org/10.1016/j.ijft.2024.100880
39. Pathak, A. K., Tyagi, V. V., Chopra, K., Sharma, M., Anand, S., Kothari, R., & Pandey, A. K. (2025). Energy, exergy, and economic analysis of solar still integrated with phase change material assimilated evacuated tube collector for wastewater treatment. Process Safety and Environmental Protection, 193, 1300–1319. https://doi.org/10.1016/j.psep.2024.11.056
40. Hemmatian, A., Kargarsharifabad, H., Esfahlani, A. A., Rahbar, N., & Shoeibi, S. (2024). Improving solar still performance with heat pipe/pulsating heat pipe evacuated tube solar collectors and PCM: An experimental and environmental analysis. Solar Energy, 269, 112371. https://doi.org/10.1016/j.solener.2024.112371
41. Fathy, M., Hassan, H., & Ahmed, M. S. (2018). Experimental study on the effect of coupling parabolic trough collector with double slope solar still on its performance. Solar Energy, 163, 54–61.
42. Hassan, H., Yousef, M. S., Fathy, M., & Ahmed, M. S. (2020). Assessment of parabolic trough solar collector assisted solar still at various saline water mediums via energy, exergy, exergoeconomic, and enviroeconomic approaches. Renewable Energy, 155, 604–616.
43. Madiouli, J., Lashin, A., Shigidi, I., Badruddin, I. A., & Kessentini, A. (2020). Experimental study and evaluation of single slope solar still combined with flat plate collector, parabolic trough and packed bed. Solar Energy, 196, 358–366.