

A Comparative Study of the Effect of Water Level on a Performance of a Hemispherical Acrylic Solar Distiller for Seawater Desalination

Journal of Mechanical Engineering,
Science, and Innovation
e-ISSN: 2776-3536
2026, Vol. 6, No.1
DOI: 10.31284/j.jmesi.2026.v6i1.8756
ejournal.itats.ac.id/jmesi

Bambang Raharjo^{1*} and La Ode Mohammad Firman¹

¹Department of Mechanical, Faculty of Engineering, Universitas Pancasila, Srengseng Sawah, Jakarta, Indonesia

Corresponding author:

Bambang Raharjo,

Department of Mechanical, Faculty of Engineering, Universitas Pancasila, Indonesia

Email: raharjo5323005@univpancasila.ac.id

Abstract

Solar energy is considered one of the most promising renewable energy sources because it has the most reliable application potential in energy conservation. The main objective in this study is to compare the performance of two hemispherical solar still models, namely the Hemispherical Solar Still Black Paint (HSSBP) and the Hemispherical Solar Still Internal Reflective Mirror (HSSIRM). Enhancing solar distiller productivity and cost efficiency is profoundly influenced by its material design. Previous literature did not utilize more efficient materials in the solar distiller. The method of the current article utilizes relatively efficient materials for the cover of the solar distiller, which is made of acrylic with a thickness of 2 mm. The cylindrical seawater basin is made of iron with a diameter of 40 cm. This comprehensive study aims to increase the clean water production of the solar distiller by using an experimental setup use water levels different starting from 1cm, 2cm, and 3cm. The experimental results revealed that the seawater basin with a depth of 3 cm in section III achieved the highest cumulative productivity. Freshwater produced from model HSSBP in section III is 955 mL/m², compared to the productivity of 1 cm and 2 cm, which yielded 557 mL/m² and 875 mL/m². Then model HSSIRM can only produce 557 mL/m². The conclusion is productivity of the HSSBP model is better than that of the HSSIRM model.

Keywords: Acrylic; Distillation; Energy; Hemispherical; Solar

Received: February 20, 2026; Received in revised: April 29, 2026; Accepted: April 30, 2026

Handling Editor: Desmas Patriawan

INTRODUCTION

Solar energy that has been available all year round in Indonesia is a potential owned as the largest archipelagic country in the tropical climate region. This country has



Creative Commons CC BY-NC 4.0: This article is distributed under the terms of the Creative Commons Attribution 4.0 License (<http://www.creativecommons.org/licenses/by-nc/4.0/>) which permits any use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the Open Access pages. ©2026 The Author(s).

extraordinary water resources with a sea area of more than 5.6 million km², or around more than 70% of Indonesia's area[1]. This condition provides a great potential to utilize solar energy in producing clean water sources that can be consumed by the community through the desalination system process. Only clean water that is suitable and meets the cleanliness criteria standards can be used by the community for daily needs[2]. With an estimated total population of around 10 million people in 2023, Jakarta, as a large city with the highest population density in Indonesia, makes the government take the issue of saving the availability of clean water very seriously [3]. Although its geographical conditions are crossed by several rivers, not all of its water resources can be utilized properly. Based on research conducted by Prasetya et al. [4], the highest groundwater pollution index value of 14.61 is in the North Jakarta area. Ridwan et al. [5] also indicated that the shortage of clean water is felt by residents living around the coastal area in the northern part of DKI Jakarta, precisely in Penjaringan District, where the quality of groundwater in the North Jakarta City area has been contaminated because of seawater intrusion, and its condition becomes brackish water. This is because the lack of infrastructure for processing raw water into clean water has made many residents prefer an alternative option to use groundwater to meet their clean water needs[6]. Continuous extraction of water sources from the ground without considering their conservation can impact land subsidence. The results of research conducted by Simatupang and Nurtyawan [7] indicated that the largest decline value was in the North Jakarta City area of -10.31 cm/year. So it will have an impact on the quantity and quality of groundwater resources used to decrease further.

The researchers from the Middle East have conducted experiments to produce fresh water from solar distillation with the principle of evaporation and condensation. Ambarita Himsar in 2018 [8] conducted a nine-day experiment on a seawater desalination system designed with a vacuum system with a pressure of around 35 mmHg to produce 900 ml of fresh water. After that, two years later, Krisdiarto [9] also developed a seawater desalination system with simple technology in the form of a rectangular glass prism equipped with a 50 x 50 x 30 cm storage box and conducted an experiment to produce 100 ml of fresh water per day. A year later, a seawater desalination system was improved by Alawee Wissam et al. [10] in the Middle East by conducting experiments on a similar form through the mechanism of using wick material on a pyramid solar still or Cord Wick Pyramid Solar Still (CWPSS). The test results indicated an improvement in productivity of up to 122% compared to conventional pyramid solar stills or Conventional Pyramid Solar Still (CPSS). In addition, the increase in daily thermal efficiency of CWPSS was achieved by 53% when using the wick rope compared to 34.5% for CPSS. Not only the prism or pyramid shape, there is also a study that has been conducted by El Hadi Attia M., et al. [11] through an experimental investigation of a dome-shaped solar still showed the results that three hemispherical stills that were built have been evaluated under identical conditions, specifically a conventional hemispherical still with black-painted walls or Conventional Hemispherical Solar Still with Black Paint Walls (CHSS-BPW), a hemispherical solar still improved with a reflective mirror or Improved Hemispherical Solar Still with Reflective Mirror (IHSS-RM), and a hemispherical still improved with reflective aluminum foil sheets or Improved Hemispherical Solar Still with Reflective Aluminum Foil Sheets (IHSS-RAFS). The experimental results showed that the total yield of the reference distiller (CHSS-BPW) reached 4750 ml/m² day, while the utilization of reflective aluminum foil sheets (IHSS-RAFS) and reflective mirrors (IHSS-RM) increased the total production to 6760 ml/m² day and 7722 ml/m² day, with an increase of 42.3% and 62.6%, respectively. In addition, the thermal efficiency of the initial reference distiller (CHSS-BPW) achieved 37.95%, while the use of aluminum foil with reflective sheets (MHSS-RAFS) and reflective mirrors (MHSS-RM) could increase the thermal efficiency to 52.18% and 59.68%, and an increase of 37.5% and 57.26%, respectively, when compared

with the initial distiller (CHSS-BPW). The exergy efficiencies of MHSS-RAFS and MHSS-RM increased by 69.61% and 123.1% when compared with the initial reference distiller. So it can be concluded that the MHSS-RM solar distiller is the most productive and efficient among the three distillers which tested.

Based on literature studies from previous research, it is indicated that the productivity of seawater distillation results is mostly influenced by its design. Various shapes and materials of seawater desalination equipment have been applied to increase freshwater productivity. Based on its shape, Kabeel A. Elnaby, et al. [12] have conducted a comparative test through experimental study results, which show that the round distillation design achieves the highest total water productivity compared to the dome-shaped and single slope distillation configurations, with each daily production output from the round distiller of 5.5 l/m², while the dome-shaped design produces 4.45 l/m² and the single slope design produces 3.1 l/m². Several studies still use glass materials in their experiments. The novelty in this study is that the use of acrylic materials can be an economical solution in terms of budget cost efficiency, better than glass. The purpose of this study is to compare the performance of two hemispherical solar still models, namely the Hemispherical Solar Still Black Paint (HSSBP) and the Hemispherical Solar Still Internal Reflective Mirror (HSSIRM). The experimental setup was divided into three sections.

METHODS AND ANALYSIS

The basic principle of a seawater desalination system in this study is to utilize the sun's radiant heat energy. When radiant energy reaches a material's surface, some is reflected, some is absorbed, and some is transmitted. The quality of the solar heat energy flowing to the Earth's surface represents a process of radiant heat transfer. Other heat transfer mechanisms besides radiation include conduction and convection [13].

The methodology used in this study is experimental to enhance seawater desalination performance in producing fresh water. The most effective parameters for improving solar distillation performance were temperature difference, water depth, surface area, evaporation, and condensation exposure area. This performance experiment is conducted using two model solar still configurations: a hemispherical solar still basin with black paint (HSSBP) and a hemispherical solar still modified with an internal reflective mirror (HSSIRM). Each seawater tank was constructed using a steel plate with a diameter of 400 mm, a depth of 100 mm, and a thickness of 1.6 mm. A hemispherical dome was built using acrylic with a thickness of 2 mm and a height of 250 mm.

Determination of the use of the dome shape is a strategy for optimizing the performance of the distillation process. The Hemispherical Solar Still was used by Obay Younis et al. [14] in their studies to enhance the amount of solar energy that can be collected by the distiller. The main method used to enhance the thermal performance of a hemispherical solar still is to enhance the water evaporation rate and the vapor condensation rate. Evaporation performance can be calculated to determine the produc-

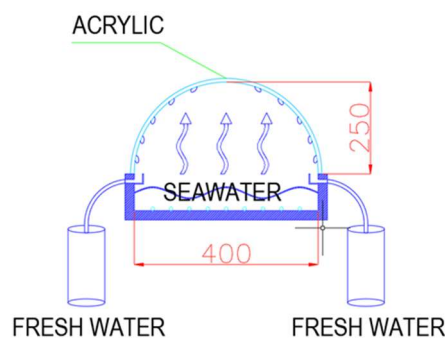


Figure 1. Hemispherical Solar Distiller.

tivity increase of a system. Production effectiveness is a main component in measuring productivity levels. The production effectiveness of a solar desalination system can be calculated using Equation 1 as follows. [15][16].

$$m_{ev} = \frac{Q \left(\frac{mL}{m^2} \right)}{t} \tag{1}$$

Where Q_{ev} is evaporative heat transfer rate of the distillation apparatus (L/m^2), t is time required during testing (hours), and m_{ev} is distillation apparatus production quantity (L/m^2h).

Another important indicator for determining the productivity increase of a system is its efficiency level. The efficiency of a seawater desalination device can be calculated by the ratio of productivity to the received solar energy. The formula used to determine the efficiency value is Equation 2 [17][18][19]. Where η is thermal efficiency (%), hfg is enthalpy of evaporation (J/kg), I is sunlight intensity (W/m^2), and A is surface area of the water container (m^2).

$$\eta, \% = \frac{m_{ev} \times hfg}{I \times A} \times 100 \tag{2}$$

This research was conducted in the Babelan area, Bekasi, Indonesia (latitude $6.1^\circ S$, longitude $107.1^\circ E$), which is close to the coast, so that environmental temperature conditions were very supportive on May 18, 24, and 29, 2025. The experimental setup used two model seawater distillation device configurations. The first one was a Hemispherical Solar Still Internal Reflective Mirror (HSSIRM), a water basin modified with reflector stickers on the inside. The second was a Hemispherical Solar Still Black Paint (HSSBP), a water basin painted black. The testing was divided into three sections for three days, with different seawater depths at each section and on each day.

The first step of the experiment used two model seawater distillation device configurations. The first one was a Hemispherical Solar Still Internal Reflective Mirror (HSSIRM), a water basin modified with reflector stickers on the inside. The second was a

Table 1. The experimental setup of the first step

Activity	Experiment Date	Seawater Depth		Seawater Volume
		HSSIRM	HSSBP	
I	18 Mei 2025	1 cm	1 cm	1150 mL
II	24 Mei 2025	2 cm	2 cm	2300 mL
III	29 Mei 2025	3 cm	3 cm	3500 mL



Figure 2. Experimental setup for Hemispherical Solar Distiller.

Table 2. Precision, range and deviation of the measuring instrument

Instrument	Accuracy	Range	Standard Error
Thermography	± 2 °C	-20 °C ~ 1000 °C	± 0,05 °C
Solarimeter	± 10 W/m ²	0,1 ~ 1999 W/m ²	± 0,38 W/m ² / °C
TDS water meter	± 2 %	0 ~ 20000 ppm	± 0,1 ppm
PH water meter	± 0,05 pH	0 ~ 14 pH	± 0,01 pH

Hemispherical Solar Still Black Paint (HSSBP), a water basin painted black. The testing was divided into three sections for three days, with different seawater depths at each section and on each day. The readings were taken from 08.00 a.m. to 04.00 p.m every hour, using the following methods. [20], [21][21]:

1. Measurement of seawater content prior to testing.
2. Measurement of solar radiation intensity.
3. Measurement of the surface temperature of the acrylic cover for each model.

RESULTS AND DISCUSSIONS

The experiment result of Section I

The first section of testing was conducted for eight hours on May 18, 2025, from 8:00 AM to 4:00 PM. The experiment activities in this section used a variable seawater depth in the basin, one centimeter (1 cm), with a measured volume of 1150 milliliters. The research object at this stage used two models, namely HSSIRM and HSSBP. The main measurement parameters in testing the seawater desalination device include measuring the intensity of sun radiance, the surface temperature of the acrylic dome, and the results of fresh water production. A graph of sun radiance fluctuations can be seen in Figure 3, which indicates the weather conditions on that day. The sunny weather before 12 a.m. start changed to cloudy after 1:00 p.m., which has had an impact on decreasing solar intensity reaching 20%. Figure 4 indicates the fluctuations in temperature measurements taken during the first testing phase. Code T1 describes the fluctuations in the surface temperature of the acrylic dome that occurred in object 1, a reservoir model with a modified reflector (HSSIRM). Code T2 describes the fluctuations in the surface temperature of the acrylic dome for object 2, a conventional reservoir model with black paint (HSSBP). The calculated average temperature for model 1 reached 42.7 °C, while the average temperature for model 2 reached 43.9 °C. In the first stage of the experiment, the average temperature of object number 2 of the HSSBP model was slightly higher by around 2% when compared to the average temperature of object 1 of the HSSIRM. Table 4 indicates the results of the seawater desalination device in the first section of testing to produce fresh water. Model 1, using a water basin with a modified reflector inside the tank or Hemispherical Solar Still Internal Reflective Mirror (HSSIRM), can produce fresh water reaching 398.09 mL/m². Meanwhile, model 2, using a conventional reservoir tank with black paint or Hemispherical Solar Still Black Paint (HSSBP), can produce fresh water as much as 557.32 mL/m². This first section of testing used seawater with a depth of 1 cm in the reservoir tank. Model 2 (HSSBP) is able to produce 28.5% more when compared to model 1 (HSSIRM).

Table 3 The result of the freshwater production section I

HSS Model	Fresh Water Productivity	
	Volume (ml)	Volume (ml/m²)
HSSIRM	50	398.09
HSSBP	70	557.32

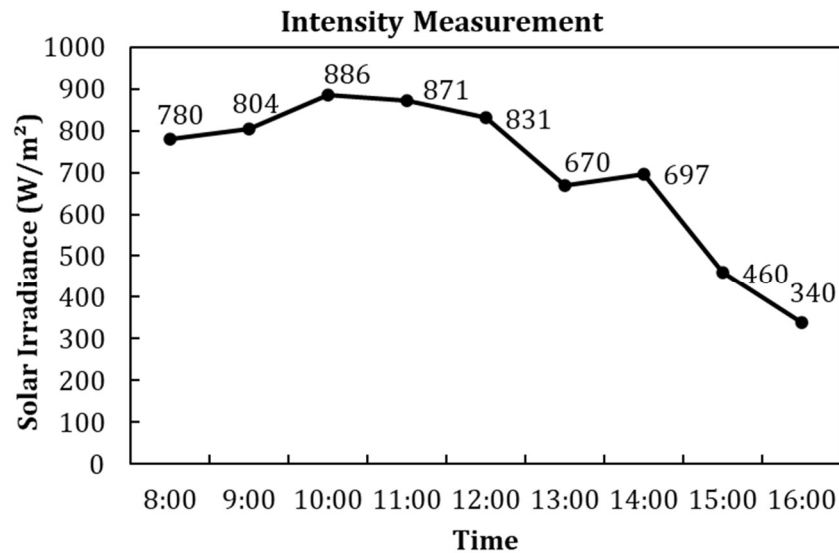


Figure 3. Solar Radiance Intensity in Section I

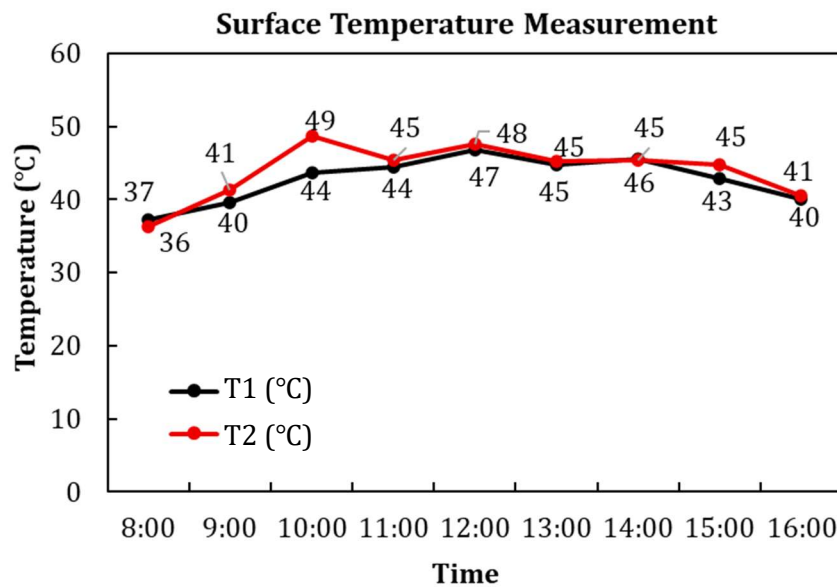


Figure 4. Acrylic Surface Temperature in Section I

The experiment result of Section II

Section two of the experiment was conducted for eight hours from 08.00 to 16.00 on May 24, 2025. This section still uses the two research objects with the same model as in the first section. The difference is that the researchers used seawater to a depth of two centimeters (2 cm), or twice as much as the first stage, with a volume of up to 2300 mL. The weather conditions in this section were slightly brighter compared to the weather conditions in the first section. Figure 5 indicates sunny weather conditions from 8:00 a.m. to 2:00 p.m. The weather conditions began to decrease after 3:00 p.m. The average intensity value on that day was around 840.9 W/m². The solar radiance on the second day was 16% better than the average intensity value on the first day. This significantly improved the temperature measurement results, better than the previous test. Figure 6 indicates the fluctuations in the acrylic surface temperature measurements of the two model objects. Legend T1 indicates the fluctuations in the acrylic surface temperature for model 1 HSSIRM with an average temperature of 46.0 °C. Legend T2 indicates the fluctuations in the acrylic surface temperature for model 2 HSSBP with an average temperature of 45.2 °C. Table 5 indicates the results of freshwater production in section 2 with a water depth of 2 cm. Model 1 Hemispherical Solar Still Internal Reflective Mirror

Table 4. The result of the freshwater production section II

HSS Model	Fresh Water Productivity	
	Volume (ml)	Volume (ml/m ²)
HSSIRM	60	477.71
HSSBP	110	875.80

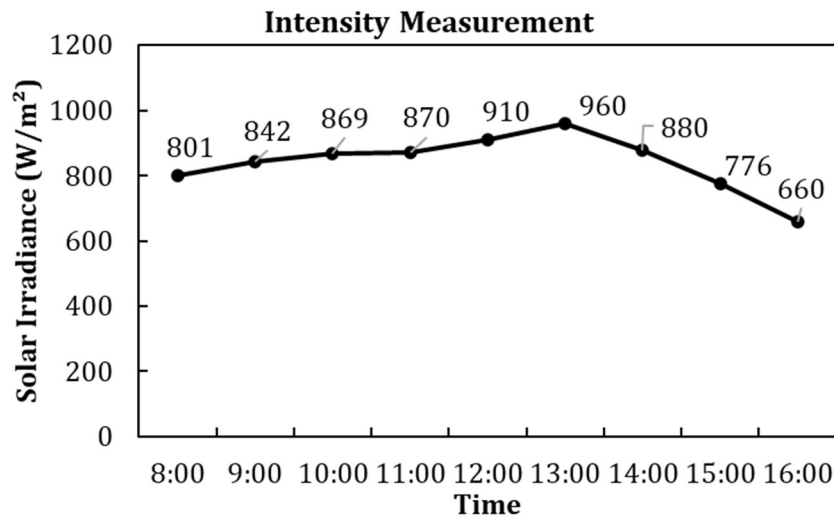


Figure 5. Solar Radiance Intensity in Section II

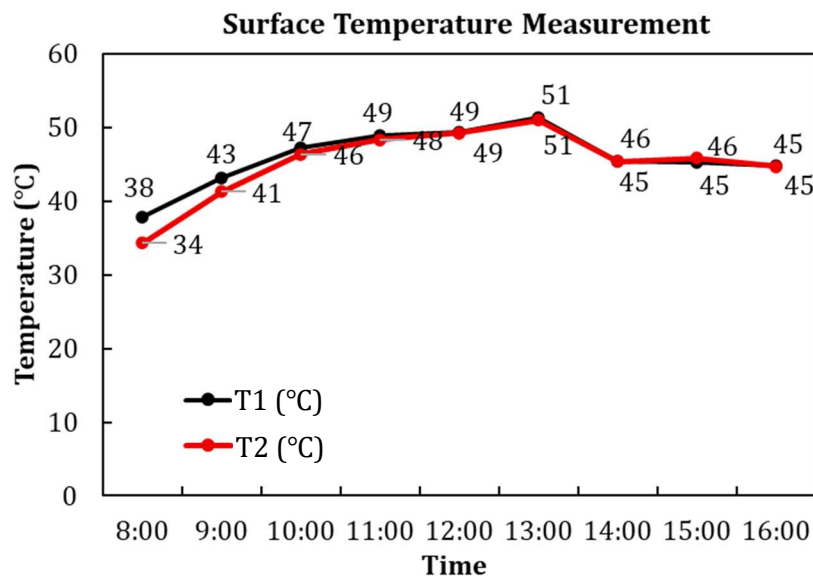


Figure 6. Acrylic Surface Temperature in Section II

(HSSIRM) results in producing 60 mL of freshwater, or equivalent to 477 mL / m². While model 2 Hemispherical Solar Still Black Paint (HSSBP) can produce 110 mL of freshwater, or approximately 875.8 mL / m². The freshwater production results of model 2 (HSSBP) are 45% more productive than model 1 (HSSIRM).

The experiment result of Section III

The experiment of section three was conducted for eight hours on May 29, 2025, starting from 8:00 AM to 4:00 PM. The difference in this section is that researchers used seawater to a depth of 3 cm, or three times more than the first section, with a volume of up to 3500 mL. The weather conditions on the third day slightly decreased compared to the second day. This can be seen in the graph of solar radiance intensity fluctuations in Figure 7, which indicates clear weather from 10:00 a.m. to 1:00 p.m. The intensity began to decrease after 2:00 p.m. The average intensity value on the third day was

approximately 677.3 W/m^2 . The average intensity value on the third day was lower than the average intensity values on the first and second days. Figure 8 indicates temperature fluctuations on the acrylic surface for both test models from 8:00 a.m. to 4:00 p.m. T1 represents the temperature fluctuation for the first HSSIRM model, with an average temperature of 46.2°C . T2 represents the temperature fluctuation for the second HSSBP model, with an average temperature of 44.5°C . Table 6 indicates the freshwater production results from the third day. The first model, Hemispherical Solar Still Internal Reflective Mirror (HSSIRM), produced 70 mL of freshwater, equivalent to 557.32 mL/m^2 . Meanwhile, the second model, Hemispherical Solar Still Black Paint (HSSBP), produced a better freshwater production of 120 mL, or approximately 955.41 mL/m^2 . The freshwater production yield of the second model object (HSSBP) was 41% more productive compared to the production yield of the first object (HSSIRM). Object 2 (HSSBP model) produced more freshwater than Object 1 (HSSIRM model) at each section stage. The HSSBP model produced the highest freshwater yield, reaching 955 mL/m^2 in the third section at a water depth of 3 cm. The summary of all sections in the first stage, conducted on May 18, 24, and 29, 2025, can be seen in Table 7, which indicates freshwater yield data from all experiment sections in the first stage.

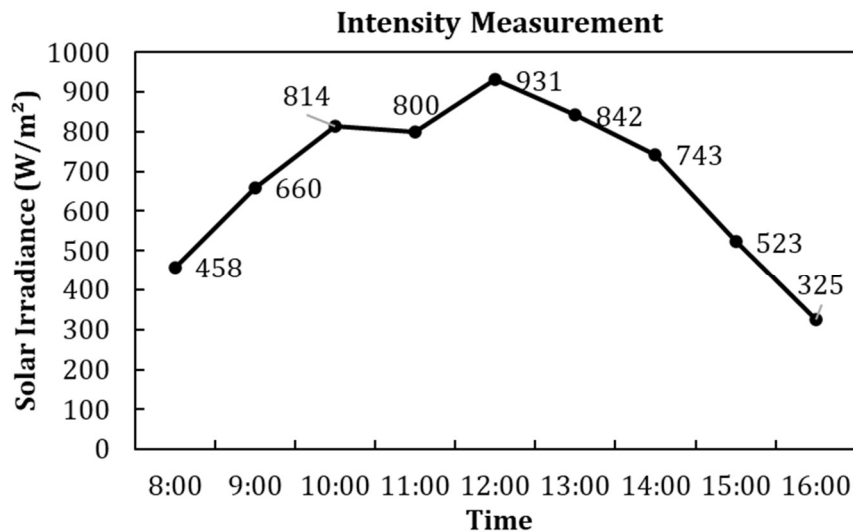


Figure 7. Solar Radiance Intensity in Section III

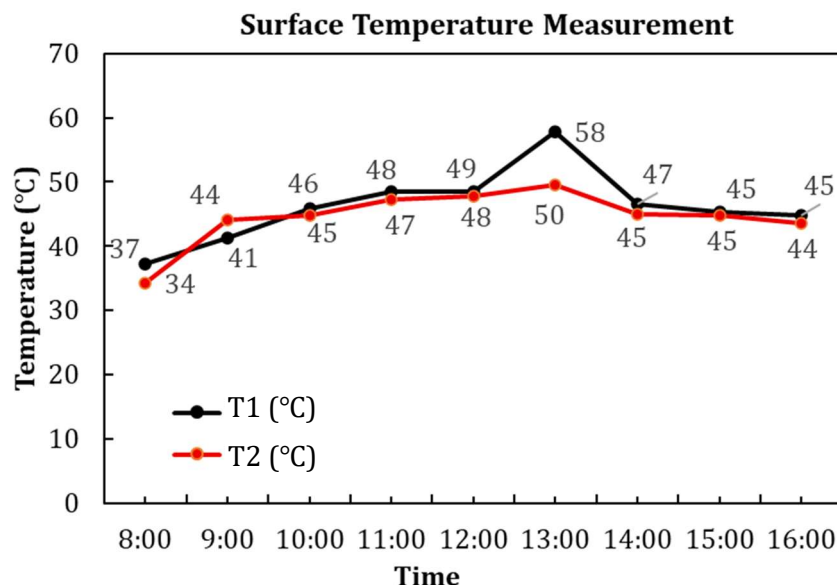


Figure 8. Acrylic Surface Temperature in Section III

Table 5. The result of the freshwater production section III

HSS Model	Fresh Water Productivity	
	Volume (ml)	Volume (ml/m ²)
HSSIRM	70	557.32
HSSBP	120	955.41

Table 6. The result of the freshwater production in sections I, II, III

Activity	Seawater Volume	Productivity Result (mL/m ²)	
		HSSIRM	HSSBP
I	1150 mL	398	557
II	2300 mL	477	875
III	3500 mL	557	955

Discussion of Productivity Data

Every section of testing the seawater desalination system produced varying amounts of freshwater due to the influence of several parameters, namely sunlight intensity, temperature, water volume, and photovoltaic system integration. Average measurement data for several parameters at each stage of testing are presented in Table 8.

Through several experimental studies, each parameter value can provide an indication of how it affects the performance of a solar still in producing fresh water. The value of solar irradiance for each experiment is the average calculation of each intensity value measured every hour. The average intensity value on the fourth day was approximately 708 W/m². The average intensity value on the fourth day was higher than the average intensity value on the third day. However, the performance of a desalination system can be assessed based on its productivity ratio, which is a higher value indicating better performance. Productivity is a comprehensive measure of performance that reflects the relationship between output and input. The expected production rates from a production process can be seen from its production effectiveness. Through equation 1, the production effectiveness of the two models is determined at each of the experiment stages.

Several average parameter values in Table 9 provide an indication of how a solar distiller can affect its performance in producing fresh water. The system performance can

Table 7. The comparison result of parameter measurement

Section	Seawater Volume	Intensity (W/m ²)	Average Temperature (°C)	
			T1	T2
I	1150 mL	704.3	42.70	43.90
II	2300 mL	840.9	46.00	45.20
III	3500 mL	677.3	46.20	44.50

Table 8. The production effectiveness in all sections

Section Test	Seawater Volume	Productivity (mL/m ²)		Production Effectiveness (L/m ² .h)	
		HSSIRM	HSSBP	HSSIRM	HSSBP
I	1150 mL	398	557	0.049750000	0.069625000
II	2300 mL	477	875	0.059625000	0.109375000
III	3500 mL	557	955	0.069625000	0.119375000

Table 9. The production effectiveness in all sections

Section Test	Seawater Volume	Productivity (mL/m ²)		Production Effectiveness (L/m ² .h)	
		HSSIRM	HSSBP	HSSIRM	HSSBP
I	1150 mL	398	557	0.049750000	0.069625000
II	2300 mL	477	875	0.059625000	0.109375000
III	3500 mL	557	955	0.069625000	0.119375000

Table 10. A comparison of present yield enhancement with similar studies found in the literature

Author(s) and reference	Solar Still System	Material	Tray Modification	Yield Accumulative (L/m ² /d)	Productivity Improvement (%)
Kabeel, et al [22]	Hemispherical	Glass Cover	Iron Fins	6.1	31.25
Attia, et al. [17]	Hemispherical	Glass Cover	Copper Tray	7.35	53.15
Attia, et al. [23]	Conical	Plastic Cover	Aluminium Ball	0.84	47.37
present	Hemispherical	Acrylic Cover	HSSBP + IRM	0.95	41.67

be determined by its productivity ratio; the higher the value, the better its performance. Productivity represents the overall performance, reflecting the relationship between output and input. The level of achievement of expected production results from the production process can be seen from its effectiveness. Table 9 indicates the freshwater production quantity produced by the two models at each stage. During the first stage of the experiment, from sections I, II, and III, the freshwater production quantity of the HSSBP seawater desalination device was higher than that of the HSSIRM model. However, during the second stage of the experiment, or section IV, the freshwater production quantity of the HSSIRM model was higher than that of the HSSBP model. The HSSIRM model distillation device has been able to improve productivity performance through the integration of the photovoltaic system. The significant increase in productivity of the HSSIRM model is evident in Table 9, where the results of the fourth section indicated a 135% increase compared to the results of the third section.

CONCLUSIONS

In summary, this study aimed to enhance the productivity of solar stills. Based on the results discussed in the previous paragraphs, the author concludes that the most significant findings from this research can be summarized as follows.

1. The hemispherical solar still made of acrylic successfully produced clean water through the experiment on the HSSIRM and HSSBP models using solar thermal energy.
2. The performance of the HSSBP desalination device was more optimal compared to the HSSIRM model in the sections I, II, and III with water depths of 1 cm, 2 cm, and 3 cm, respectively.
3. The highest clean water productivity from each model is indicated in Section III with a water depth of 3cm.

4. Consideration for the desalination tank to make it more rust-resistant than seawater.
5. A more effective method is needed to capture the clean water condensation that has adhered to the dome walls.
6. Consideration for integration with the solar panel modules to enhance clean water productivity.

ACKNOWLEDGEMENTS

The authors highly appreciate the Mechanical Department of Universitas Pancasila for the enabling environment, service, and support. Special appreciation to persons, groups, or organizations that have contributed to the research or to the writing of the article.

DECLARATION OF CONFLICTING INTERESTS

The authors declare that they have no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

FUNDING

The author(s) disclosed receipt of financial support for the research, authorship, and/or publication of this article.

REFERENCES

- [1] Kementerian Koordinator Bidang Kemaritiman dan Investasi Republik Indonesia, "Keputusan Menteri Koordinator Bidang Kemaritiman dan Investasi Republik Indonesia No 169 Tahun 2020 Tentang Rencana Strategis Deputi Bidang Koordinasi Kedaulatan Maritim dan Energi Tahun 2020 - 2024," 2020.
- [2] L. Febriawati, R. Mellaty, and T. Widowati, "ANALISIS AKSESIBILITAS AIR BERSIH DALAM RANGKA PENINGKATAN KETAHANAN KELUARGA DI DKI JAKARTA Clean Water Accessibility Analysis in Increasing Family Resilience in Dki Jakarta."
- [3] M. Yuwandari, T. Y. W. M. Iskandarsyah, M. N. Barkah, *et al.*, "Zonasi Intrusi Air Laut pada Sistem Akuifer Tertekan Atas Cekungan Air Tanah Jakarta Zoning of Seawater Intrusion in Upper Confined Aquifer System of Jakarta Groundwater Basin", [Online]. Available: <http://jlbgeologi.esdm.go.id/index.php/jlbgeologi>
- [4] D. A. Prasetya, I. P. Santikayasa, and I. H. Azizi, "Analisis Indeks Pencemaran Airtanah di DKI Jakarta dengan Interpolasi Spasial," *Jurnal Teknik Sipil dan Lingkungan*, vol. 6, no. 3, pp. 177–186, Dec. 2021, doi: 10.29244/jstil.6.3.177-186.
- [5] N. M. R. Ridwan, R. A. Afla, R. Rizki, et al., "Akses air bersih di pesisir Jakarta terhadap kesehatan dan kesejahteraan masyarakat," *Waste Handling and Environmental Monitoring*, vol. 1, no. 1, Feb. 2024, doi: 10.61511/whem.v1i1.2024.453.
- [6] W. Fauziah Rizka, "Analisis Pengembangan Infrastruktur Penyediaan Air Bersih Di Wilayah DKI Jakarta," *Nusantara Journal of Multidisciplinary Science*, vol. 1, no. 11, 2024, [Online]. Available: <https://jurnal.intekom.id/index.php/njms>
- [7] G. M. Simatupang and D. R. Nurtyawan, "Analisis Penurunan Muka Tanah DKI Jakarta Dengan Metode Differential Interferometry Synthetic Aperture Radar (DInSAR)," 2023.
- [8] Himsar Ambarita, "Rancang Bangun Alat Desalinasi Air Laut Sistem Vakum Alami Dengan Tenaga Surya", *Jurnal Flywheel*, vol. 9, 2018.
- [9] A. W. Krisdiarto, A. Ferhat, A. W. Krisdiarto, et al., "Penyediaan Air Bagi Masyarakat Pesisir Terdampak Kekeringan dengan Teknologi Desalinasi Air Laut Sederhana," *DIKEMAS (Jurnal Pengabdian Kepada Masyarakat)*, vol. 4, no. 2, Oct. 2020, doi: 10.32486/jd.v4i2.532.

- [10] Wissam H. Alawee, F. A. Essa, S. A. Mohammed, et al., "Improving the performance of pyramid solar distiller using dangled cords of various wick materials: Novel working mechanism of wick," *Case Studies in Thermal Engineering*, vol. 28, Oct. 2021, doi: 10.1016/j.csite.2021.101550.
- [11] M. E. H. Attia, A. E. Kabeel, M. Abdelgaied, et al., "A comparative study of the effect of internal reflectors on a performance of hemispherical solar distillers: Energy, exergy, and economic analysis," *Sustainable Energy Technologies and Assessments*, vol. 47, Oct. 2021, doi: 10.1016/j.seta.2021.101465.
- [12] A. E. Kabeel, M. El Hadi Attia, M. Abdelgaied, et al., "Comparative performance of spherical, hemispherical, and single-sloped solar distillers," *Desalination Water Treat.*, vol. 317, p. 100051, Jan. 2024, doi: 10.1016/j.dwt.2024.100051.
- [13] La Ode Mohammad Firman, *Teori & Penerapan Energi Baru dan Terbarukan*, Cetakan Pertama., vol. xxii. Ponorogo: Uwais Inspirasi Indonesia, 2024.
- [14] O. Younis, A. K. Hussein, M. E. H. Attia, et al., "Hemispherical solar still: Recent advances and development," *Energy Reports*, vol. 8, pp. 8236–8258, Nov. 2022, doi: 10.1016/j.egy.2022.06.037.
- [15] O. Badran, A. Alahmer, F. A. Hamad, et al., "Enhancement of solar distiller performance by photovoltaic heating system," *International Journal of Thermofluids*, vol. 18, May 2023, doi: 10.1016/j.ijft.2023.100315.
- [16] H. Bahrami, M. Derayatifar, and S. Ehsan Shakib, "Improvement of low-cost solar-powered desalination technologies in low-light intensity," *Energy Conversion and Management: X*, vol. 24, Oct. 2024, doi: 10.1016/j.ecmx.2024.100718.
- [17] M. E. H. Attia, A. E. Kabeel, M. Abdelgaied, et al., "Enhancement of hemispherical solar still productivity using iron, zinc and copper trays," *Solar Energy*, vol. 216, pp. 295–302, Mar. 2021, doi: 10.1016/j.solener.2021.01.038.
- [18] L. Hadj-Taieb, Suha A. Muhammad, Wissam H. Alawee, et al., "Enhancing water productivity and cost-effectiveness in hemispherical solar stills using sandy beds, reflectors, and a vapor extraction fan," *Results in Engineering*, vol. 21, p. 101983, Mar. 2024, doi: 10.1016/j.rineng.2024.101983.
- [19] S. Algburi, G. A. Baker, O. K. Ahmed, et al., "Influence of collector type and the glass cover cooling on the performance of the solar distiller integrated with the solar collectors," *Energy Reports*, vol. 11, pp. 6015–6022, Jun. 2024, doi: 10.1016/j.egy.2024.05.076.
- [20] H. O. Abdulridha, H. G. Hameed, and B. N. Merzah, "Performance study for single slope solar still integrated with different types of solar collectors," *Desalination Water Treat.*, vol. 319, Jul. 2024, doi: 10.1016/j.dwt.2024.100538.
- [21] A. E. Kabeel, M. Abdelgaied, M. El Hadi Attia, et al., "Optimization and thermo-economic assessment of hemispherical solar distillers with a flat and concave basin: Experimental approaches," *Desalination Water Treat.*, vol. 317, p. 100223, Jan. 2024, doi: 10.1016/j.dwt.2024.100223.
- [22] A. E. Kabeel, M. El Hadi Attia, M. Abdelgaied, et al., "Performance assessment of the hemispherical solar distillers with the extended cylindrical iron fins: An experimental investigation," *Alexandria Engineering Journal*, vol. 61, no. 12, pp. 11149–11157, Dec. 2022, doi: 10.1016/j.aej.2022.04.018.
- [23] M. El Hadi Attia, A. E. Kabeel, M. Abdelgaied, et al., "Performance optimization and comparative study of a conical solar distiller with optimized construction of aluminium balls as energy storage materials," *Desalination Water Treat.*, vol. 319, p. 100504, Jul. 2024, doi: 10.1016/j.dwt.2024.100504.