International Journal of Machine Tools and Maintenance Engineering

E-ISSN: 2707-4552
P-ISSN: 2707-4544
IJMTME 2023; 4(1): 09-20
Received: 15-09-2023
Accepted: 20-10-2023

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Exploring the enhancement of solar still performance through the utilization of solar water collectors, rotating hollow cylinders

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Abstract
Present water resources are insufficient to fulfil future demand. Without eating or drinking, humans can go days, weeks, or months, but not longer than a week. Businesses and households are increasingly using water. Drinkable water is produced by filtering brackish, sewage, and saltwater in various countries. Some countries prioritise drinking water production. This article examines heat exchange solutions scientists have used to increase solar still water output. Numerous authors have created and examined basic and advanced solar stills. These authors examined what happens when the container, collector, and water's chemical and physical properties change. One technique to increase solar distillation yield is with a cylindrical collector. The system's surface area will rise. Our research examines the different ways solar stills have been made more efficient.

Keywords: Solar energy, solar water collector, rotating hollow cylinder, thermodynamic analysis

1. Introduction
Solar stills collect, chill, and purify water with dissolved chemicals. These devices use sunlight to disinfect polluted or plant-collected water in areas without clean water. Condensation traps and large-scale concentrated solar stills are static solar energy devices. As solar radiation passes through a transparent collector, water evaporation purifies the air. Water vapour condenses and enters the tank when it contacts its cooler interior. Natural precipitation and mechanical distillation are identical. Sunlight evaporates heated liquid water. Water vapour condenses into liquid when cooled after evaporation. This microorganism-filtering procedure removes enzymes, heavy metals, and other pollutants from water. Finally, generate potable water. To boost distillate water supply in industrial applications using solar stillness, research on various stills has been pushed. This literature review will discuss solar still systems with emptied glass tubes for heating, thick glass covers, thermal insulation, and mechanical components. Discussed will be sunlight, temperature, wind speed, still material kind, depth, glass cover angle, and shaft or drum rotation. This section examines how these changes affect thermal efficiency and drinking water supply.

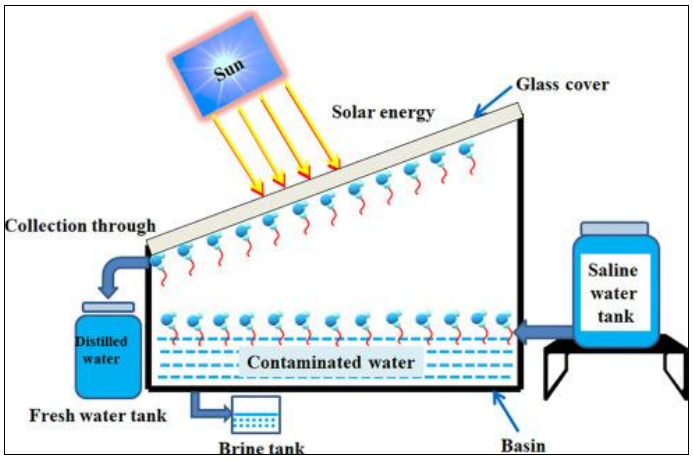

Fig 1: Solar water collector

2. Solar distillation classification

There are two primary categories of solar energy utilization technologies: active and passive. These procedures rely on solar coupling techniques for effective operation. In addition to the stationary element, solar collectors, photovoltaic panels, and concentrators are utilized in the active solar energy production process. Solar radiation is absorbed directly by passive solar technology, which continues to absorb solar radiation.

2.1 Passive solar stills

Systems that use solar energy as their main thermal energy source and those that combine solar and other thermal energy sources.

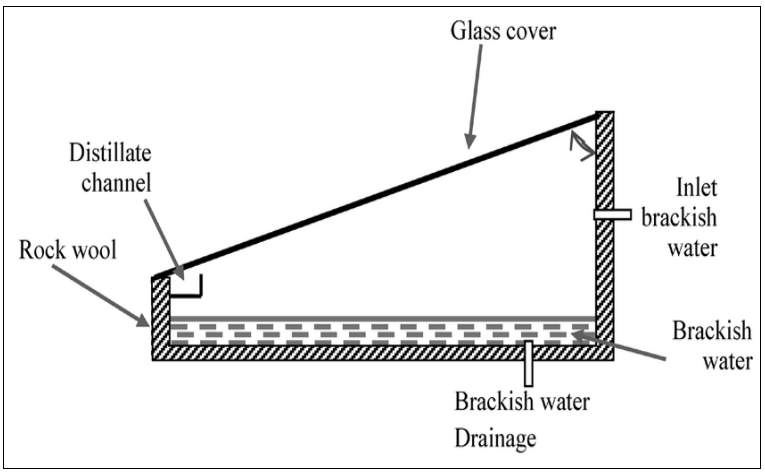

Fig 2: Passive solar still

2.2 Active solar stills

Any industrial facility or solar collector can provide this thermal energy. This energy is combined with passive solar radiation to speed evaporation.

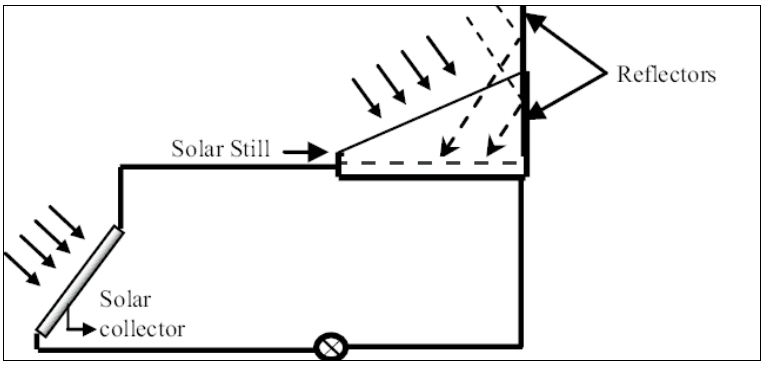

Fig 3: Active solar still

Bhupendra Gupta *et al.* Nanoparticles improve heat transmission surface area, improving a fluid's thermal properties. Effective and productive enhancement was achieved with CuO nanoparticles.

Singh *et al.* focuses on the potential of partially-shaded photovoltaic flat panel (FPC) solar panels for use in hybrid solar thermal trains.

Muthu Manokar *et al.* proves that forced convection system can boost potable water output in an active distillation plant. This can be achieved by reducing the hood temperature and considering active solar distillation variables that affect evaporation rate. Desalination systems produce more freshwater by increasing sensible and latent thermal energy.

Praveen Kumar *et al.* constructed an active hybrid PV/T still and a passive single-slope still for comparison. Utilising salt water accelerates the cooling process and raises the solar PV module's efficiency.

Kamran Mohammadi *et al.* built a multiscale heat exchanger were combined with those from an experimentally equivalent washbasin collector for this investigation. When used in conjunction with the suggested heat exchanger, serpentine heat exchangers and parallel channels enhance distillation output by 30.4% and 34.1%, respectively.

Hisham A. Maddah *et al.* implemented stepwise linear regression (SLR) to examine water-glass temperatures (Tw-Tg), evaporation coefficients (hewg), and constant outputs. Utilising insulation materials with minimal affinities, such as polyurethane (PU) or silicon dioxide, is a viable strategy for increasing the building's static output.

Shanmugan *et al.* used TiO2 nanoparticles and Cr2O3 as coatings for basin liners in this study of static solar performance. Copper was chosen for the lining of the container due to the fact that it provides excellent insulation throughout the year.

Milad Mohsenzadeh *et al.* present the prototype of a lightweight, transportable passive solar still: a small basin with a flat slope. components' thermal inertia, bulk water's thermal inertia, and evaporation chamber salinity. Empirical evidence suggests that daily throughput drops can be as high as 21%.

Solar stills with a single and double angle of inclination

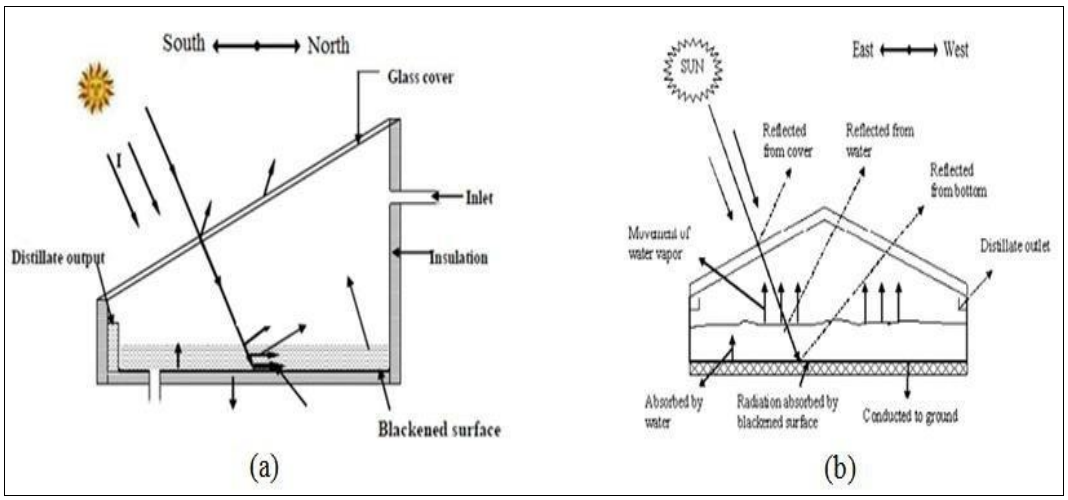

Fig 4: a) monoclinic solar still, (b) bi-tilted solar still

Wissam Hamid Aliwi applied single-movement, double-inclined solar still and modified to see whether it could be more efficient. This improvement improves condensation without extra methods. It was far larger than its containment to achieve this. Solar reflecting panels at the still's base can heat the distillation tank by absorbing solar energy.

Elango *et al.* used fixed solar monoclinics Tin oxide (SnO2) and zinc oxide (ZnO) nanofluids yielded less than water (29.90%), but Al_2O_3 yielded more. Higher yields by 12% and 18% frequency.

R. Arun Kumar *et al.* utilized experimental evaluation, standard solar stills and a single-slope basin were employed. Two solar pools with identical angles of tilt were built, one perpendicular to the other. By putting a rule in one of the stills, condensation and external agitation were mimicked. Steam was moved to the external condenser by the static condenser using a fan.

Singh *et al.* studied a hybrid PVT solar panel collector as function when partially shaded, it was put through a battery of tests. To do so, a thermal model of the system was built with only a fraction of its covering removed.

Poonam *et al.* utilized solar still and a three-state heat exchanger to gather data for energy matrices, water and power production costs, eco-economic assessments, and external economic evaluations. Overall water usage costs are lowest in Scenario 4, with Scenarios 3 and 2 coming in a close second and third. Energy costs are factored in per distillation and expressed in kilowatt-hours. 1.73 kWh/m^2.

Elnaby *et al.* compared the Clinical Severity Scale, the ISS, and the CSSISSS among clinical trials conducted in Egypt Freshwater yielded at 6.2 kg/m2, ISS at 5.04 kg/m2, and CSS at 4.24 kg/m2 were all found to be created by CSSISS. Compared to CSS, ISS and CSSISS were 18.87 and 46.23 percent more efficient, respectively.

M.R. Karimi Estahbanati *et al.* determined the impact of internal reflectors (IR) on the summer and wintertime efficiency of single-slope solar distillation, both theoretically and empirically. The production of distillate is increased by 22% in the summer, 34% year-round, and 65% in the winter by installing IRs on every wall. Additionally, the statistics show that when the cloud factor rises, the IRs' efficacy drops significantly when placed on every wall.

Kalpesh and Jenish tested Single and double-slope solar stills had little samples of filament material placed in their valleys for study. At 0.01 m and 0.02 m, jute fabric production exceeded that of black cotton cloth by 18.03% and 21.45%, respectively.

Lei Mu *et al.* proved that the quantity of water collected from the sun by a regular solar still may presumably be increased by employing a refraction-based approach. Single-slope solar troughs have had light focused at their bases by the addition of Fresnel lenses, commonly known as FRLs. Distillation yield improves as a result of the system's increased efficiency. Using a cool effect created by pushing air or increasing DW has also been shown to be effective.

Erfan *et al.* used A double-tilt solar still's efficiency was evaluated in Zahedan, Iran, using a PVM and T/PV collector.

Om Prakash *et al.* applied Dunkle's model to make predictions for evaporative and convective heat losses, which are then compared to experimental data. Specifically, at a depth of 12 centimetres.

Akram *et al.* studied compared an indoor monoclinic solar still to an outdoor solar water warmer using PCM capsules and a high-frequency ultrasonic evaporator. High-frequency ultrasonic evaporators increased outdoor solar water heater water production by 415%.

Fayadh M. Abed*et al.* utilized solar stills with and without chemical colouring are compared to see which produces more potable water from salt water. Chemicals enhance solar still yield and efficiency. The efficacy of solar distillation can be influenced by several elements, encompassing wind velocity, temperature, and the availability of solar radiation. Atef Ghandour & Khaled Shalabi used elements such as mesh material, temperature, wind speed, the pace at which cooling water is pumped over the glass cover, and the rate at which saline water is added all affect the amount of evaporation. Daily output was increased by 17% when lattice patterns were used.

Ahmed Rahmani and Abdeloahab Boutriaa employs analytical and experimental methods to probe the impact of condenser size on the year-round NCL static solar energy characteristics. Results showed that a higher continuous daily output is associated with a larger condenser area up to a certain point, but that after that point, the effect becomes insignificant and the link disappears.

Sabah *et al.* applied Fortran 90 numerical analysis. Sunshine intensity, aquarium plate and water temperature, glass cover

and surface temperature, and hollow cylinder surface temperature were evaluated. Mousa Abu-Arabi *et al.* Modified solar stills' performance should be evaluated alongside that of conventional solar stills, solar stills connected to an external collector, and solar stills cooled by glass. Increases in output of 0.9, 3.4, and 3 ml/min were achieved by the SC, SCC, and SCCP systems, respectively, while using SAT as the PCM. Mohammad Hemmat Esfe *et al.* examine the radiation intensity affects solar still performance. April water productivity in Semnan, Iran.

Oussama Rejeb *et al.* According to the findings, the potential for producing distilled water is affected by a number of parameters, including water depth, ambient temperature, insulation thickness, and the factors having the largest impact on solar radiation.

Laxmikant D. Jathar *et al.* minimized the space between the absorber panels and the condenser cover will increase solar energy harvesting efficiency. Either a single- or dual-axis solar sun tracking system can boost output.

Ramasamy Dhivagar *et al.* used magnetic black iron material has multiple uses, including heat absorption and storage. Because of the magnetic powder's ability to store heat, the MPSS is more efficient at peak solar hours than the CSS.

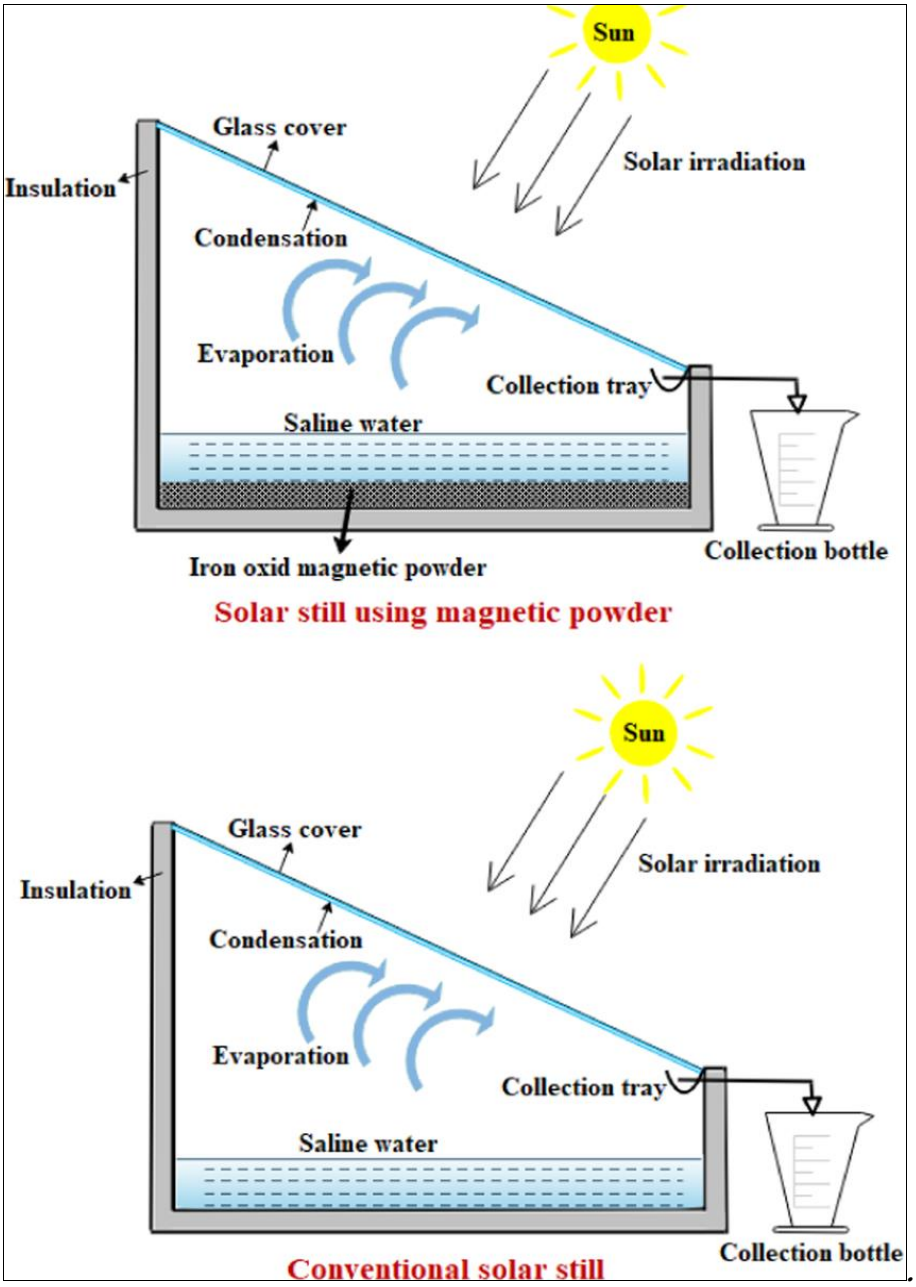

Fig 5: Variations in solar basin water levels

A.E. Kabeel used A dark container, which may receive more sunlight through a translucent solar tube, is incorporated into the new design to increase water evaporation. Lightweight and locally available materials were used to construct the TSS for this reason. With refrigeration, TSS production and efficiency are respectively 31, 4, and 32 percentage points higher than with the indicated method.

Muthu Manokar *et al.* Water production from uninsulated pyramidal solar stills was 8.26% higher than that of uninsulated single-trough solar stills. Without insulation, the daily solar system efficiency was around 26.1 percent, and with insulation, it was nearly 28.5 percent. Kalpesh V. *et al.* applied stationary still to employ different water levels and

glass cover placements. When applied to north-south glass coverslips, 0.1% CuO nanoparticles boosted yields by 27.27% and 26.60% at 20 and 10 mm water, respectively. A solar still's efficiency depends on its vertical dimension, reservoir depth, water surface slant, and glass cover. The solar still's glass cover was angled to maximise production. We also correlated hourly accumulation, thermal efficiency, internal heat transfer coefficient, and water depth. Hamid Reza Goshayeshi, Mohammad Reza Safaei employs two units, the one with the convex absorbent plate produced more water daily.

Vikash Kumar Chauhan, Shailendra Kumar Shukla constructed a three identical, but slightly skewed, replicas for this experiment. The first two categories all featured south-facing, single-slope basins (SBSS) with slope angles in the 25–30 degree range. The third concept involved an SS SBDS with a 15-degree east-west inclination. Desalination was shown to be driven by an almost undetectable temperature difference between the aquarium water and the condenser's glass cover.

2.3 The description of the impact that the spinning cylinder has on solar distillation

For the impact case George M. Ayoub & Lilian Malaeb utilized the solar freezer's evaporative surface area was significantly increased by installing a hollow, slowly revolving cylinder. Hussein Hayder Mohammed Ali AL-Kahia) expressed the way for increase the available surface area for distillation, a spinning drum is used in this technique. The study included the assembly of two solar arrays, one manufactured from flat panels adapted for use atop a solar water collector and the other permanently installed in the ground. Modified solar energy production peaked in January at 3,540 ml/m2 at a reservoir depth of 2 cm.

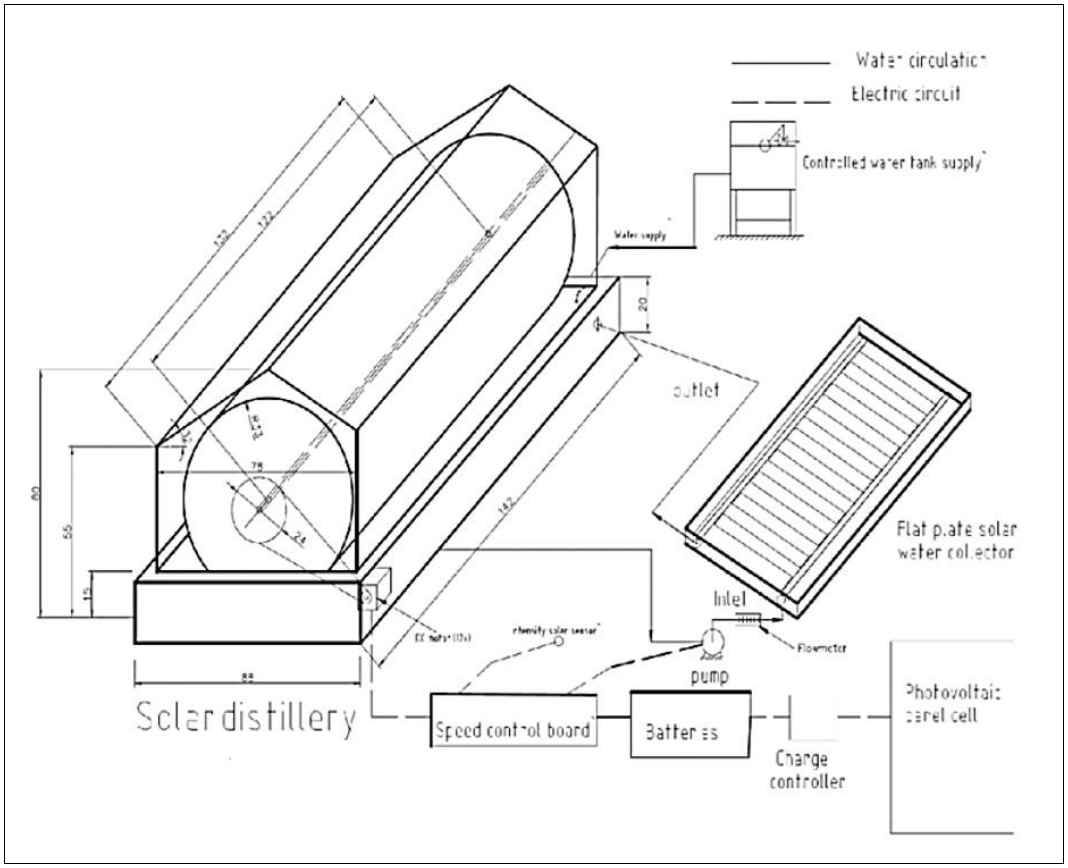

Fig 6: Scheme of solar distillation

Abdullah *et al.* used saltwater covering to expedite evaporation and finally placed the solar water heater atop the distillation cylinder. The remaining cylinder received an external condenser. The final evaluation stage analysed drum distillation apparatus effectiveness. The researcher found that the condenser, heater, and nanofluid functioned best at 0.1 rpm.

Ahmed and Ali maximize evaporation, a hollow cylinder is rotated inside to lessen the pure water film's border layer thickness using the solar panel. Speeds of 0.5, 1, and 3 rpm were used in the tests. Adding a modified solar shredder and an external solar collector allowed for the reservoir's water temperature to be raised. Low rotational speeds (below 1 rpm) were discovered to produce the highest output from the hollow cylinder.

F.A. Essa *et al.* used cutting-edge method rotates a cylinder to reduce water vaporisation in the solar tube. Using 0.1 RPM without a filament, closed-end ubular cylinders create 121% more than open-end ones.

Wissam H. Alawee *et al.* adjusted to the pyramidal solar still improves water surface area exposed to sunlight while decreasing layer thickness. Pyramid distiller containers are made of four concentric cylinders that meet snugly. We used three electric heaters to heat the basin's water. The ideal RPM for maximum output was 0.5.

Essa *et al.* utilized a solar still with rotating discs creates a unique distillation method. This experiment determines the best aquarium surface area for sun radiation and evaporation salt reduction. Performance of a modified rotary disc solar still was tested at disc rotation rates of 0.02, 0.05, 0.1, 0.5, 1.0, 2.0, 3.0, and 4.0 rpm.

Energy from the sun of the following substance type Vikrant

P. Katekar & Sandip S. Deshmukh applied Paraffin wax increases single-tank passive solar system production, power, and efficiency. Hollow cylindrical pin fins on the absorbent plate promote heat transmission best because paraffin wax has weak thermal conductivity. Lab tests show copper oxide nanoparticles in paraffin wax enhance output by 125.

R. Samuel Hansen *et al.* used absorbers for various wicking materials and plate designs. This research aimed to find a solar-powered desalination plant material. Researchers developed materials with better absorbency, capillary height, porosity, water repellency, and thermal conductivity. Test filaments include several materials. At warmer temperatures, hydrocoral fleece's 69.53% porosity wicks best.

Dsilva Winfred Rufuss *et al.* applied four sun stills (SS) were created specifically for these experiments. The three varieties of sun stills with varying levels of paraffin were designated as SNPCM-1, SNPCM-2, and SNPCM-3 are paraffin-TiO2, paraffin-CuO, and paraffin-GO. Although PCM has lower melting and solidifying points than NPCM, PCM has greater thermal conductivity.

C. Elango *et al.* examine thermal models created for various kinds of solar stills and the ways in which their efficiency has improved over time. Based on our research, we determined that every time a new solar cell is developed, specific parameters should be taken into account. This research is really helpful since it reveals important details about how solar energy could be improved to provide clean water. The study's usefulness lies in its ability to supply researchers with this information, which is crucial for effective product distribution in rural areas. The paper finishes with some recommendations for selecting a solar still with a flexible design. We conclude with several recommendations for additional research. A.E. Kabeel *et al.* used PCM-filled closed copper pipes enhance productivity in the range of 4.1-4.31 L/m2/day as compared to standard pipelines. Zhenyuan Xu *et al.* studied innovations in solar interfacial heating and evaporation enthalpy recycling have boosted the effectiveness of passive solar desalination.

Mohammad Al-harahsheh *et al.* investigated the solar water desalination using a solar collector and PCM. The PCM stores daytime solar latent heat that can be released when temperatures drop. Condensation forms on the double-glazed lid as water vapour rises from the container and contacts cold water.

George Ni *et al.* proposed desalination using floating solar evaporation structures and interfacial solar heat localisation. However, salt accumulation and heat containment remain issues. We experimentally show that an evaporative structure may continually produce clean steam in a saline ocean. Evaporation-friendly design and a low-cost polymer membrane condensation cap provide 2.5 litres of drinkable water everyday.

Amer M. Mamkagh *et al.* used freshwater output of conventional trough-type solar stills was enhanced by as much as 135% when submerged metal tubes were used as condensers. Subterranean condensate pipelines are able to condense more drinkable water because of the greater moisture levels in the soil. Nidham M. Jamalludeen utilized and received water from the Shatt al-Arab, where the Tigris and Euphrates meet. Water treatment plants purify and distribute water to neighbourhoods. Water samples are tested by scientists to assure microbe-free drinking water. The researchers studied two water bottling companies and eleven Basra neighbourhoods. 10 of 10 water samples included coliform bacteria. Sabah T. Ahmed, Hussein H. Mohammed Ali studied water's physical and chemical qualities. This investigation uses Kirkuk neighbourhood water supply systems and classic and experimental solar stills. We tested two of each water type. Total dissolved solids, acidity, alkalinity, conductivity, mineral, and acid concentrations were measured. Any pH outside 7–8.3 was bad.

Wahran M Saod *et al.* examine Euphrates River WQI fluctuations in Anbar Governorate. Several monitoring stations will provide data. The GCI was computed using pH, EC, TDS, T.H., TUR, DO, Alk, Ca2+, Mg2+, and Na+. This calculation uses the Canadian Council of Ministers' Environmental Water Quality Index.

Memet Varol Studied the primary components and causes have indicated that natural and anthropogenic soluble salts, natural and anthropogenic suspended particles, anthropogenic nutrients, and organic waste all contribute considerably to the deterioration of water quality.

S. Joe Patrick Gnanaraj *et al.* The major and secondary basins on top are 100 cm2. To allow outside light, a 100 cm2 by 20 cm2 double-sided glass cover was placed over the still's bottom receptacle. The two-sink setup uses inverters, a flat-panel collector, and a tiny solar pool for power. Small solar ponds averaged 6,249 ml per day, ranging from 2,745 to 5,650.

Hitesh Panchal *et al.* applied more vacuum tubes and solar-powered devices boost manufacturing. For the catcher's stomach, there were 14 vacuum chambers and a 1-square-metre basin. Calcium stones were the SHSM for this experiment. Researchers in Patan, Gujarat, studied evacuated tube, evacuated tube with calcium stone, and calcium stone solar stills from January to June. Mohammad Behshad Shafii *et al.* tested a new type of solar still powered by thermoelectric components. Compared to when the tubes were only half-filled with water, full-filling them resulted in a 27% increase in output, according to the study's authors.

G.S. Dhindsa & M.K. Mittal applied a standard trough attached to the VMED solar still to improve its ability to produce distillates at all hours of the day and night. The trough was filled with several floating wicks to increase the still's production during the day. They still heated the water in the trough overnight in batch mode, maximising the use of the solar pond's limited energy output.

Table 1: The typical results from studies on the solar still

Ref No	Name of the author	Title	Year	Type of study	Productivity	Improve productivity
1	Dr. Bhupendra Gupta & other	Performance Enhancement using Nano Particles in Modified Passive Solar Still	2016	Practical	A nanoparticle-modified solar still produces 3,445 ml/m2 day at 5 cm and 3,058 at 10 cm.	Nanoparticles improved artificial snow.
2	*D.B. Singh & other*	Experimental studies of active solar still integrated with two hybrid PVT collectors	2016	practical and theoretical	Average annual productivity is estimated at 121.29–883.55%.	

3	*Muthu Manokar & other*	Different parameter and technique affecting the rate of evaporation on active solar still -a review	2017	theoretical	Solar stills with SSP produce 52.36 percent everyday, while those without SSP produce 43.80 percent.	
4	*B. Praveen kumar &* other	Experimental investigation on hybrid PV/T active solar still with effective heating and cover cooling method	2018	Practical	PV/T may increase thermal and electrical efficiency 25%.	Salt water cooling the solar PV module boosts power and water distillation.
5	*Kamran Mohammadi & other*	Experimental investigation of a double slope active solar still: Effect of a new heat exchanger design performance	2020	Practical	Solar distillates with the breakthrough heat exchanger surpass parallel channel distillates by 34.1%.	Increased efficiency, brine temperature, pressure drop, condensing surface temperature difference, evaporation surface temperature difference, and heat transfer fluid volumetric flow rate generate more distillate than the conventional heat exchanger design.
6	Hisham A. Maddah & other	Performance estimation of a mini-passive solar still via machine learning	2020	Practical, theoretical, digital	At 120 mL/day, productivity peaks.	Lowering the input flowrate may increase peak temperatures and efficiency in evaporation.
7	*S. Shanmugan & other*	Experimental study on single slope single basin solar still using TiO2 nano layer for natural clean water invention	2020	Practical	In winter, the solar system produces 5.39 L and in summer, 7.89 L.	Inside the bowl, Cr2O3-containing TiO2 nanoparticles with varied hybrid bond topologies are applied.
8	*Milad Mohsenzadeh & other*	Development and validation of a transient model for a passive solar still considering the aspect ratio of the evaporation chamber	2022	Practical		Model parameters include salinity concentration, evaporation chamber aspect ratio, component thermal inertia, and bulk water thermal inertia.
9	Wissam H. Alawee	Improving the productivity of single effect double slope solar stil by simple modification	2015	Practical	The improved still increases distillate output by 18%-24% in the same reservoir.	An larger distiller and reflecting plates raise the distillation basin water temperature, increasing the condensation region.
10	Elango & other	Performance study on single basin single slope solar still with different water nanofluids.	2015	Practical	Experiments demonstrate that the modified still produces distillate 39.48% faster than the normal still.	Alumina nanofluids were 29.5% more productive than others.
11	*R. Arun Kumar & other*	Performance enhancement of a single basin single slope solar still using agitation effect and external condenser.	2016	Practical	39.48%.	Decreased basin water-inner glass cover temperature due to vevapor extraction increases condensation.
12	*Singh& other*	Experimental studies of active solar still integrated with two hybrid PVT 911 collectors	2016	Practical & theoretical	The average annual productivity rate is 121.29–883.55%.	Flat plate collectors were used to test a hybrid PVT system with a solar still.
13	*Poonam& other*	"Energy matrices, exergo-economic and enviroeconomic analysis of an active single slope solar still integrated with a heat exchanger: A comparative study	2018	Experimental & Theoretical analyses	A glass cover boosts graphite and copper oxide microparticle yields by 47.80% and 57.60%, respectively.	An ideal single-slope active solar system with a heat exchanger has energy and environmental expenses. solo and with others.
14	*ABD Elnaby & other*	Experimental study on conventional solar still integrated with inclined solar still under different water depth	2018	Experimental setup and methodology	ISS, CSS, and CSS collected 24 kg of freshwater in the experiment. ISS was 18.87–46.23 percent more productive than CSS.	This was discovered by comparing CSS with and without integration. (dw) = 0.02 m. CSSISS improved yield more.
15	*M.R. Karimi Estahbanati & other*	Theoretical and experimental investigation on internal reflectors in a single-slope solar still.	2016	Theoretical and experimental	IRs on both still walls increase distillate production by 65% in winter, 22% in summer, and 34% year-round.	Instant IR on front and side walls increases still efficiency 18%. On the rear wall, IRs increase output 22% yearly.
16	*Kalpesh V. Modi & Jenish G. Modi*	Performance of single-slope double-basin solar stills with small pile of wick materials	2019	Experimental setup and methodology	Small heaps of jute fabric generated 18.03% and 21.45% more at 0.01% and 0.02% water depth than modest stacks of black cotton cloth.	The jute still generated more alcohol than the black cotton still.
17	*Lei Mu & other*	. Enhancing the performance of a single-basin single-slope solar still by using Fresnel lens: Experimental study	2019	Experimental	FRL increased pure water output by 467% (L/m2/day).	Using FRL
18	Erfan Hedayati-Mehdiabadi & other	Exergy performance evaluation of a basin-type double-slope solar still equipped with phase-change material and PV/T collector.	2019	Theoretical	Increasing mass flow from 0.001 to 0.01 kg/s increased fresh water output by 10.6% and workout efficiency by 27.0%.	Mix PCM with warmed salt water to generate drinkable water at night.
19	*Om Prakash & other*	Thermal analysis of domestic type single Slope–Basin solar still under two different water depths.	2020	Experimental setup and methodology	At 12 cm, yield is highest; at 3 cm, 0.13157 kg/hr.	Condensing and evaporating surfaces affect yield. Temperature gradient on surface. Variable decreases yield.
20	Akram H. Abed & other	Experimental investigation of modified solar still coupled with high-frequency ultrasonic vaporizer and phase change material capsules	2021	Experimental	In all cases, production ranged from 1,409 to 1,840 to 4,842 to 7,255 ml/m2.	Check water quality before adding an external condenser to enhance solar still performance. The solar still's condensation surface will grow.

21	*Fayadh M. Abed & other*	Experimental investigation on the effect of using chemical dyes on the performance of single-slope passive solar still	2022	Experimental	With an average solar irradiation of 800 W/m2, July yielded 4.25 L/m2, whereas February yielded 0.95 L/m2.	Chemical components boosted solar still efficiency and output, the study found. Chemical solutions boost 2.5-metre-deep water flow by 40% in February (49% of total) and June (53%).
22	Atef Ghandour & Khaled Shalabi	Improving Productivity of Solar Energy Distillation Still For Sea Water	2016	Experimental measurements and the calculations performed,	Performance is 17% higher than typical absorber sheets.	For reinforcement, galvanised cascade and lattice steel sheets are employed.
23	Rahmani, A., & Boutriaa, A	Numerical and experimental study of a passive solar still integrated with an external condenser	2017	Numerical and experimental	The model predicts 4.73 kg/m2 summer and 2.71 kg/m2 winter NCL solar system output.	After a certain point, increasing the condenser area did not boost daily still productivity.
24	S. Tarik Ahmed and H. Hayder Mohammed Ali	D THEORETICAL STUDY OF THE CONVENTIONAL AND MODIFIED SOLAR STILL	2020	Using FORTRAN 90, theoretical numbers were investigated.	A basic solar still generated 240% less distillate water than an upgraded solar still.	When a hollow cylinder in a solar still spun, flat plate solar water collector thermal efficiency and distillate water output were studied.
25	*Mousa Abu-Arabi & other*	Theoretical modeling of a glass-cooled solar still incorporating PCM and coupled to flat plate solar collector.	2020	Theoretical	The SCC and SCCP-SAT outproduced the SC system by 1.8 and 2.3, respectively.	Three types of solar stills exist: PCM, external collector attached, and conventional. Paraffin wax, pentahydrate sodium thiosulfate, and trihydrate sodium acetate were PCMs.
26	Mohammad Hemmat Esfe & other	Simulation of the impact of solar radiation intensity on the performance of economical solar water desalination still in Semnan province	2021	Numerical simulation methodology	The least and most evaporation occurs from seven in the morning until twelve in the afternoon.	This study examines how radiation intensity affects solar still water productivity over time.
27	*Oussama Rejeb & other*	Investigation of a solar still behaviour using response surface methodology.	2021	Methodology, Mathematical model and numerical solution	Distillate production at 0.01 metres water depth rises 1.62 kg/m2 compared to 1.61 kg/m2 with insulation thickness of 0.05 metres. A increase occurred.	Reduced radiated heat losses and improved insulating thickness increase distillation efficiency as water temperature rises.
28	Laxmikant D. Jathar & other	Effect of various factors and diverse approaches to enhance the performance of solar stills: a comprehensive review	2021	Theoretical and experimenta	The single-basin multi-step solar basin generates 1100 watts per square metre per day1, whereas the multi-wick solar yields 1198 watts per square metre per day1.	Researchers observed that located distilleries in high-solar-radiation areas, using the Solar still type, and running in optimal temperatures can boost daily distillate production. Latitude-proportional inclined solar stills yield more.
29	Ramasamy Dhivagar & other	Performance enhancement of a solar still using magnetic powder as an energy storage medium-exergy and environmental analysis	2022	Theoretical and experimenta	The investigation found that MPSS produced water 31.2% faster than CSS.	The magnetic powder's thermal energy helped the MPSS work better during the sun's hottest hours.
30	*A.E. Kabeel & other*	Improving performance of tubular solar still by controlling the water depth and cover cooling	2019	Experimental	The TSS with the shallowest water produced 4.5 L/m2 per day, whereas the TSS with the deepest water produced just 3 L/m2.	In testing, the proposed TSS increased yield by 31.4% and efficiency by 32.2%.
31	Muthu Manokar & other	Effect of water depth and insulation on the productivity of an acrylic pyramid solar still – An experimental study	2019	Experimental	Pyramid solar stills performed 8.26% and 19.46% worse than single-basin solar stills at one centimeter-deep water.	Experimentally, acrylic condensing lids boost still efficiency. Keeping the water-acrylic condensing cap temperature gap wider causes this.
32	Kalpesh V. Modi & other	Impact of orientation and water depth on productivity of single-basin dual-slope solar still with Al2O3 and CuO nanoparticles.	2020	experimental	productivity increased 27.27% and 26.26% above the 0.1% Al2O3 nanoparticle control group.	An experiment on nanoparticles and single-basin, dual-slope solar still production.
33	Hamid Reza Goshayeshi, Mohammad Reza Safaei	Effect of absorber plate surface shape and glass cover inclination angle on the performance of a passive solar still	2019	experimental	This number applies to proof and design operations. the generally believed belief that a smaller angle produces better stills.	the widespread perception that narrower-angle cameras produce better still photographs.
34	Vikash Kumar Chauhan, Shailendra Kumar Shukla	Experimental study of effect of glass cover tilt angle of solar still in winter season of India's composite climate	2022	experimental	The nighttime experiment with polystyrene covering on the glass cover yielded 435, 735, and 320 ml/m2.	The tilt angle is usually governed by latitude, but a recent study discovered that it changes with the seasons.
35	George M. Ayoub & Lilian Malaeb	Economic feasibility of a solar still desalination system with enhanced productivity.	2014	Experimental	Over several months, experiments showed that the upgraded product's production grew by 200% to 300%.	Compared to standard procedures, a spinning cylinder can improve evaporation by 200 *%+*
36	Hussein Hayder Mohammed Ali AL-Kahia	EXPERIMENTAL AND THEORETICAL INVESTIGATION ON A NEW DESIGN OF A SOLAR STILL COUPLED WITH FLAT PLATE COLLECTOR	2019	Theoretical and experimenta	Modified solar stills produced at least 250% more in summer and 340% more in winter than regular ones.	As the basin's water temperature rises, the distillery may generate more water.
37	A.S. Abdullah & other	Rotating-drum solar still with enhanced evaporation and	2019	Theoretical and experimental	Condenser, heater, and nanofluid production were	Improved nanofluid efficiency and water heater efficiency.

		condensation techniques: Comprehensive study			optimised for 0.1 RPM. Our freshwater output was 9,220 L/m2, 350% greater than the typical 2,050 L/m2.	
38	Sabah T. Ahmed, Hussein H. Mohammed Ali	EXPERIMENTAL INVESTIGATION OF NEW DESIGN OF SOLAR WATER DISTILLATION COUPLED WITH FLAT PLATE SOLAR WATER COLLECTOR	2020	experimental	MSS freshwater output was 3540 ml/ m2.day, and CSS was 1225 ml/ m2.day	Turning the hollow cylinder increases the solar still's evaporation area and reduces the untreated water film's boundary layer. Both changes occur simultaneously.
39	*F.A. Essa & other*	Improving the performance of tubular solar still using rotating drum – Experimental and theoretical investigation	2021	Theoretical and experimental	Closed-ended tubular drum production rose 175% and open-ended production 140%.	While maintaining 0.1 rotations per minute, the tubular drum output increased 136% for open ends and 121% for closed ends.
40	Wissam H. Alawee & other	Improving the performance of pyramid solar still using rotating four cylinders and three electric heaters	2021	experimental	Thanks to the heaters and reference still, MPSSRC could produce 9100 mL/m2 of distillates daily. Output rose 214%. Cylinder output peaked at 0.5 RPM.	The pyramid distiller has a basin with four rotating cylinders. Three underwater electric bulbs raised the temperature.
41	*F.A. Essa& other*	Rotating discs solar still: New mechanism of desalination. Journal of Cleaner Production	2020	experimental	Corrugated-disk solar still with wick produced 124% purer freshwater distillate than industry norm.	Flat and corrugated wicking and non-wicking discs.
42	Vikrant P. Katekar & Sandip S. Deshmukh	A review of the use of phase change materials on performance of solar stills	2020	Theoretical and experimenta	The use of paraffin increased productivity by 307.54%.	Daytime heat can be recycled for nighttime distillation to maximise solar still efficiency.
43	*R. Samuel Hansen & other*	Performance analysis on inclined solar still with different new wick materials and wire mesh	2015	Experimental	The still produced 4.28 litres of distillate daily using water coral fleece and a weir mesh-stepped absorber plate.	Coral fleece also wicks well for solar stills. Porosity is 69.67%, absorbency 2.0 seconds, capillary rise 1.0 mm/hour, and heat transfer 34.21 W/m^2 °C.
44	D. Dsilva Winfred Rufuss & other	Effects of nanoparticle-enhanced phase change material (NPCM) on solar still productivity	2018	Experimental	SSPCM's output rose 26% and 35% over SSNPCM-1 and SSNPCM-2, however SSNPCM-3 produced just 3.92 l/m^2/day.	Solar still efficiency and productivity are examined with nanoparticle-enhanced phase change material (NPCM).
45	C. Elango & other	Thermal models of solar still—A comprehensive review.	2015	Theoretical and experimenta	Compared to a basin-style solar panel, the new design increased efficiency by 20%.	We emphasise efficiently evaluating novel glossy composite materials with high transparency and thermal conductivity.
46	A.E. Kabeel & other	.Augmentation of diurnal and nocturnal distillate of modified tubular solar still having copper tubes filled with PCM in the basin	2020	Experimental	Copper tubes with phase change material (PCM) can produce 8.82 to 9.05 L/m2/day more than typical tubular systems.	We connected perchloroethylene (PCM)-filled copper tubes to the solar still's receiver to maximise water distillation between sunrise and sunset for this study.
47	Zhenyuan Xu & other	Ultrahigh efficiency desalination via a thermally-localized multistage solar still	2020	Experimental	One sun's irradiation produces 5.78 L m^2 h1 and over 75% of the production is condensation.	Capillary-fed multistage thermally localised multistage solar still (TMSS) combines interfacial solar heating with vaporisation enthalpy recycling to improve passive solar desalination efficiency.
48	Mohammad Al-harahsheh & other	Solar desalination using solar still enhanced by external solar collector and PCM	2018	Experimental	Maximum yield is 4300 ml/(m2 Day).	The external solar collector supplied renewable energy and increased system efficiency. It increased production in the evening, when the PCM's energy storage capacity was most affected.
49	George Ni & other	A salt-rejecting floating solar still for low-cost desalination.	2018	Experimental	***2.5***litres per square metre daily1.	Interfacial solar heat localization-based floating solar evaporation devices are a new, efficient desalination method. This desalination technique uses interfacial solar heat localisation. It's still hard to maintain a reasonable temperature without salt accumulation.
50	Amer M. Mamkagh & other	Efficiency Improvement of the Condensation Pipes in the Soil for a Basin Type Solar Desalination Unit	2020	Experimental	Compared to basin-type solar still condensers, buried metallic tubes increased freshwater generation by 135%.	Circumference, depth, diameter, and substance of the soil moisture and condensation conduit determined solar still effectiveness.
51	Nidham M. Jamalludeen	Bacteriological Assessment of Tap Water and Two Types Of Bottled Drinking Water Available At Basra City, South Of Iraq	2019			
52	Sabah T. Ahmed, Hussein H. Mohammed Ali	Physical and Chemical Characteristics Comparison of the Drinking Water and Water Produced from the Conventional and Modification Solar Water	2019			

		Distillery				
53	Wahran M Saod & other	Water quality index along the Euphrates between the cities of Al-Qaim and Falluja	2021			
54	Varol, M	Use of water quality index and multivariate statistical methods for the evaluation of water quality of a stream affected by multiple stressors: a case study.	2020			
55	Joe Patrick Gnanaraj & other	Enhancing the design to optimize the performance of double basin solar still	2016	Theoretical and experimental	Still, the double basin generated 5650 mL and the single basin 2745 mL.	Each side of the still's lower bowl has a 100 cm2 glass panel to let sunlight in. More efficient double basin stills use solar ponds, flat plate collectors, and reflectors.
56	Panchal, H., Hishan & other	Solar still with evacuated tubes and calcium stones to enhance the yield: An experimental investigation	2020	experimental	Using SSET and SSETCS enhanced yields by 113.52% and 104.66%.	According to recent research, more solar stills with evacuated tubes produce more.
57	Shafii, M. B., Shahmohamadi & other	Examination of a novel solar still equipped with evacuated tube collectors and thermoelectric modules	2016	Experimental	Forced convection allowed the system to yield 1.11 kg/m2/h and 68% hourly efficiency.	When water levels were fully filled in evacuated tubes, output increased by 27%.
58	Dhindsa & other	Experimental study of basin type vertical multiple effect diffusion solar still integrated with mini solar pond to generate nocturnal distillate	2018	Experimental	The revised model showed 49.87% productivity, 71.21% efficiency, and 56.92% yield.	After dark, a microsolar pond might batch-heat basin water to make distillate. Floating wick basins boosted daily output.

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