Advancements in Solar Stills for Smart City Application- A Review

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Abstract

Today's major challenges are water and energy. Groundwater overuse has caused a drinking water deficit. To get additional water, deep tube wells are drilled. Deep tube well water requires more energy. Today's problems also include energy. New water and energy research can overcome these problems. Groundwater is generally salty, and inhumane. This requires new water-correcting technology. RO technology is the best. However, this method wastes more water. For this reason, researchers are creating further technologies, with solar-powered water purification being the most effective and causing the least water damage. In the current work, all research done in this field is compiled together.

Keywords*:* Solar Still, Heat Pipe, Hybrid Solar device, Evaporation-Condensation, Smart city , Energy, Performance

1. INTRODUCTION

Research papers are selected for the literature review on the double slope solar still having various production techniques to improve the productivity of the solar distillation devices. All research papers are selected as the present scope of the work on solar still research work [1]. There may be an urgent need for clean, pure consuming water in many nations [2, 3]. Regularly water assets are brackish and or comprise harmful bacteria and therefore cannot be used for consumption [4]. In addition, there are numerous coastal places in which seawater is abundant but potable water is not to be had. Pure water is likewise wished for in some industries, hospitals, and colleges. Solar water purification is particularly successful in low-water areas like Rajasthan, where residential electricity is scarce [5]. Researchers created solar stills using solar energy-based distillation (Solar distillations). Distillation has industrial applications [6]. Since the government began giving everyone clean water. In these areas without energy, solar plants have been developed [7, 8]. Saline water is cleaned using solar thermal energy in a small space by sun distillation. Glass hangs over this space [9]. Total energy loss is avoided by insulation. This device allows you to easily collect pure water by tilting the glass. Evaporation and condensation are the mechanisms that solar

distillation uses. Among the many applications of solar energy are those for heating, drying, cooking, and power generation [10]. A wide variety of machines can be powered by solar energy, including automobiles, planes, boats, satellites, and even calculators. We can't rely on solar energy forever [11].

2. METHODOLOGY

A suitable topic and keywords have been selected from my research field and from my research interest. Various research papers have been studied and formulated a clear objective. Based on objectives and keywords more than 160 scopes and sci-papers from various research sources have been downloaded and from these, important papers have been selected for the review process and prepared a specific research hypothesis that is to be explored. A result has been founded and concluded after reviewing various papers with my best.

3. REVIEW OUTCOMES

K.S. Maheswari et al [12], In their research report, the researcher analyzed clear glass covers. This uses a double-slope solar still. Researchers hope to boost solar still production. PVC pipe might replace transparent glass in this research. Glass is weaker than PVC. PVC has downsides. Clear glass may disperse solar radiation more than PVC pipes; thus, the conclusion of the study is to avoid PVC in low-solar-radiation areas but utilize PVC sheets in high-solar-radiation areas.

RahulAgrawal et al [13] This research produced a Modified Solar Still. PCM materials boost productivity in this task. This study employed binary eutectic Phase change materials (palmitic acid and stearic acid) and steel wool fibber PCM (SWF). This report contains all experimental findings utilizing both materials. Four distinct experiment settings are designed in this work to discover the most ideal cases: MDSSS-1 (PCM with 4 cm water depth), MDSSS-2 (PCM with 3 cm water depth), MDSSS-3 (PCM with 2 cm water depth), and MDSSS-4 (PCM + SWF with 2 cm water depth). All four examples are compared to a both side tilled solar still. MDSSS-4 has the finest both side tilled solar still results.

S. Joe PatrickGnanaraj and V. Velmurugan[14]This project aimed to enhance solar still distillate yield. Traditional stills were altered inside and externally. Three solar stills (corrugated basin, black granite, wick) were designed. One had outside reflectors. Finally, an entirely new one was erected. Conventional and modified stills were compared and analyzed. In finned corrugated basins and outside reflectors, water temperature climbed fast during the day. In declining and off-sunlight hours, black granite kept the water warmer. Forenoon production utilized exterior reflectors. Black granite increased daytime and night-time production. Traditional stills collected 1880 ml/m2d. The finned corrugated basins, black granite, wicks, reflectors, and internal and external improvements increased distillate production by 58.47, 69.84, 42.333, 93.393, and 171.43% over the typical still.

Modi, K.V., Jani, H.K. & Gamit [15] This study examines the impact of nano-particles on a single-basin double-sloped solar still utilizing using different different position of glass covers and with different water depths. Two single-basin dual-slope solar stills were tested. At varying water depths, a still without nanoparticles and one containing 0.1% Al2O3 nanoparticles were compared. Glass was covered East–West and North–South. Al2O3 nanoparticles enhanced North–South distillation by 19.40%, 28.53%, and 26.59%. CuO nanoparticles increased yield by 58.25% and 56.31% for 19.95 mm and 9.97 mm water depths, respectively. At 19.95 mm and 9.97 mm water depths, the still containing 0.1 percent CuO nanoparticles showed higher productivities. CuO nanoparticles increase single-basin dual-slope solar still thermal performance.

N.Muthu Saravanan et al[16] Pollution, urbanization, climate change from fossil fuel usage, and a lack of storage knowledge are causing water shortages. Beaches lack fresh water. This requirement motivated a low-cost, renewable energy-based desalination method. Solar stills purify waste or brackish water. Built and tested under normal conditions, the solar still. Kanchey marbles are studied as solar still energy storage. Kanchey stones improve solar stills by 16.32%.

S STuly et al[17]This study explores the effects of a solid quadrangular fins and paraffin-wax as a heat storage material and an outward condenser on an active both side tilled modified solar still. Five scenarios evaluate modified, finned, and classic double slope SSs. The greatest double slope SS productivities are 3.1, 2.72, and 2.5 L/m^2. SS efficiency is 39.74% with external condenser and 30% without. A condenser boosts modified SS production by 10%. Reformed SS is 14.23% more efficient than finned and regular SS. Traditional, finned, and modified SS had CPLs of 0.014, and 0.012 $\$/L/m^2$, respectively. SS modification may be a cheap approach to meet rural water needs.

Abdulla et al [18] has examined a hi-tech purification arrangement of humidification and de-humidification (HDH) unit associated by six wick solar water distillation system. Different pressing materials (pen cushion and thorn pad) and water flow rates (1.1, 2.0, 3.2, and 4.0 kg/min) were tested. Dehumidifiers made humidifier vapor thick. Desalination was tested day-and-night. Wick stills were evaluated. The HDH unit's salty high-temperature water fed the wick stills. Aspen cushions in the humidifier produced more freshwater than thistle trees. The best distillate was made in an HDH unit at 4.0 kg/min. At 4.0 kg/min, usual picked up yield proportion (GOR) increased from 2.56 for an HDH unit working during the day to 4.55 in the afternoon and night-time. Cross-breeding increased the GOR from 5.13 to 5.72 by increasing the water flow rate from 2.0 to 4.0 kg/min.

Pounraj et al[19] finished the test to manufacture water and power. In this, a solar PV-powered Peltier framework was coupled to a crossover PV/T dynamic solar still. The Peltier in this still improves disappearing and build up distillation. The dynamic half-breed PV/T framework was tested and found to be the best. The suggested dynamic cross-breed solar PV/T still is 30% more efficient than the

traditional latent still and 38% more efficient than the genuine solar PV framework.

Naroei et al[20] studied hybrid SS and upgraded the warm efficiency of a solar water heating system using a solar tracker. Lab-scale robotics allows solar panels to tilt and spin. The control system is adjusted to face the solar panels all day. The sun's location on the celestial circle is determined by its solar stature and azimuthal point. Warm conductivity is generated by adjusting the solar panels, heat exchanger, and capacity system. A solar pyranometer measures the sun light force. Solar tracker results show a 40% increase in overall stored heat energy compared to fixed solar panel angles. Summer is great for low slants, while winter requires steeper slants.

Manokar et al[21]studied the efficiency of a P-V panel incorporated solar water still to get more pure water and amount of electricity. The framework's performance is analyzed from several viewpoints, including pure water production rate, efficiency, PV panels and exergy efficiency. Using this type combined solar still obviously we will get maximum distillate (7.2 kg). 7.2 kg, 4.5 kg, and 3.5 kg of freshwater produced. Daily vitality and efficiency of exergy of a tilled solar panel based solar water stiller with side wall and bottom protections are greater considered to various circumstances. Day-by-day efficiencies of 34.3%, 38.5%, and 71.4% and exergy efficiencies of 1.35%, 2.37%, and 4.53% were obtained for an inclined solar panel basin solar still with no protection, sidewall protection, and side wall plus bottom protection, respectively.

Rabhi et al[22] show a solar still with rod balances and an outward condenser. An experimental investigation compares the improved solar still with stick balances safeguard condenser to the standard still. This study compares the warm conduct (shield and glass temperature changes) and pure water production capabilities of a solar still with stick blades for the shield and condenser. All analyses are done in Gaffs-meteorological Tunisia's conditions. Experiments are shown, measured, and discussed to illustrate the modified solar still's usefulness.

Rashidi et al[23] examined exergy for a double sided sloped solar still heated by thermoelectric modules to improve its thermal performance. Thermo electric modules were used to warm water and improve the solar still's effectiveness. The results are from 10 days and nights of testing at Semnan. Finally, the cost per litre of water production has been determined. The results indicated that heat sink and thermoelectric heating increase water temperature. This predicts a drop in productivity when night falls. Exergy efficiency also increases during testing seasons. The framework's exergy efficiency is about 26% at 2 p.m. Life cycle analysis shows that distilled water costs 0.15 and 0.25 $\$/L/m^2$ during the day and night, correspondingly.

Ahmed Rahmani et al[24] studied the influence of the condenser zone on NCL solar still highlights in summer and winter. PC code predicts the influence of condenser zone and twist speed on daily yield in summer and winter. The results

showed that nevertheless daily production increases with condenser area until a fundamental value beyond which its effect becomes unimportant. The wind effect is stronger for small condenser areas, according to research. The re-enactment shows that NCL solar still's highest daily production in summer and winter is 4.73 kg/m2 and 2.71 kg/m2, respectively.

Sarray et al[25]Heat and mass exchange wonders and the entropy rate of sticky air in a single solar are studied. By examining the district area and time (day and month), the following should be considered: Minimum glass cover thickness, water depth, and glass cover slant point should be comparable to the locale scope for maximum solar still efficiency. Solar power, daytime, and water salinity affect still production. Summer's long days increase productivity. Salty treated water reduces solar still production. Increasing the water temperature increases both heat exchange via dissipation and water vapor exchange by dispersion, boosting still production. Preheated saline water with solar energy seems ideal and least difficult for this circumstance. Warm solar disasters are caused by conduction between the basin plate and the surrounding.

Manokar et al[26]studied two solar still wall and absorber plate combinations. Finned acrylic and galvanized iron solar stills are studied. This study used a simple single basin solar still, adjusting water depth from 10mm to 30mm, local time, and absorber plate material. Acrylic is more productive than galvanized iron, according to his analysis. Acrylic solar stills lose little heat.

Kumar et al[27]tested a wedge-shaped pyramid solar-still with an tilled solar still. Field experiments validate theoretical analysis in their study. This work constructs a 0.650.650.15 m solar still with an angled glass covering. This study's input parameters include sun intensity or year, basin area effective utilization, and raw water depth. Field experiments calculate yield and efficiency. Experiments in this study reach 50°C. Pyramid with slanted solar still yields 7.52 kg/m.

4. RESULT

This work designs four experiments to find good cases. 4cm PCM, 3cm PCM, 2cm PCM, 2cm PCM + SWF. All four are double-slope solar stills. The best double slope results are from MDSSS-4. It can be observed that CuO nanoparticles increase productivity compared to Al2O3 nanoparticles. It has been noticed that the effect of wind is stronger for a condenser if its area is small in NCL solar still and increased daily production. It studied exergy for double side-sloped solar water still heated by thermo-electric modules to improve thermal performance. Thermoelectric modules were used to expand the solar still's efficiency. The dynamic solar PV/T hybrid still is 30% more efficient than the traditional latent still and 38% more efficient than the genuine solar PV framework. An angled solar panel based basin still with side wall (all side) and foot(base) protection produced the most distillate (7.2 kg). A solar still with sidewall and bottom protection produced 7.2 kg, 4.3 kg, and 3.5 kg of fresh water.

Hybrid SS and solar tracker efficiency were studied. Solar trackers increase stored heat energy by 40% compared to fixed panel angles. It has been observed that acrylic is more productive than galvanized iron. Nano paint is another future scope for solar still productivity improvement.

5. CONCLUSION

After review of various research papers some important research gaps are identified and present in this section, which are following:
1. It was found that the use of cloth materials can improve the efficiency of the solar still, so use of cloth is solar distillation is better option.
2. Double slope solar still shows the better performance than the single slope solar still, so in present study double slope solar still is selected for the study.
3. Revolution of the cloth material in the solar still setup can improve the water distillation of the solar still, so revolving cylinder is used for the present study.
4. The conclusion of the study is to avoid PVC in low-solar-radiation areas but utilize PVC sheets in high-solar-radiation areas.
5. It is clearly indicated that by increasing the water depth in solar still basin the fresh water production is decrease due to large quantity in the solar still which required time for the proper latent heat generation in the solar still.

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