Performance of Single Solar Still with Different volume Pebble

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Abstract

The process of solar distillation and desalination is the process of purifying and removing salty water into good and pure water used for drinking and cooking. Solar energy: For the purpose of increasing the use of this type of energy, materials with the ability to store thermal energy in the basin are utilized solar panels, and these solar panels are made of composite wood material and stainless steel material with A glass pane tilted at an angle of 32 degrees on the horizontal surface. Solar energy is increased and saved through the use of pebbles that store thermal energy. Three different sizes, small and large, and a mixture of the two types of pebbles were used in Experimental analysis. Experimental results have proven that the small pebble is the best and maximum result that can be produced, up to 3.730 liters / m2 / per day.

Keywords: Solar still sink , Different pebbles, energy storage material, Renewable power, composite materials.

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INTRODUCTION

Solar energy is employed globally for the purification of saline water. The seawater is transformed into safe drinking water using solar still. For increasing the yield rate a straightforward solar still, many designs and techniques are used[1]. Conclusion: During shining hours, the manufacturing output drops as the heat rate of the water in the sink increases. The greatest yield value of single-sink solar were determined just 2.6 l/m2/daily for 55 mm height [2-4] . According to A.S. Hammood, who had looked into the thermal performance and economic analyses all year long, the single slope still had proven to be more effective and cost-effective than the pyramid solar still[5]. Depended on the primary on parameters including depth of salt water, the width of insulation, and the angles of glass execution, [6]. devised an algorithm to predict daily yield value of a solar at a one slope. Indirect vertical solar stills were built by Boukarete et al. using evaporation and condensation box and a plate flat of collector. It produces a daily output of up to 1.333 l/m2/ day 1–5. In contrast to older tube solar stills, Ahsan et alvery .'s durable, inexpensive, and light weight polythene plate were used to cover a tubular still. This improved the rate of saline water evaporation and condensation[7–9]. By creating a type regenerative tray of solar still, ReddyKS et al. have demonstrated the effectiveness of a solar still. Basel has created hemispherical solar panels with a daily average efficiency of 33% [10]. When comparing the execution of many solar stills, found CPC fitted and a tubular still offers highest output [11]. Using a stacked tray array, NafeyAS built a many-stage indirectly heat desalination of solar still and studied tandem distillation and heat recovery . In their study of still performance[12], also found the water height and type of sink material are key factors in determining the productivity, while the production and efficiency depend about the location, air temperature, the intensity of sun's radiation, the water height in basin, the glass's angle, the width of the cover glass, the still's heat rate, and the air speed [13-14]. With the help of sprinklers to improve condensation rates, black die to boost effective output, and lower water levels to increase yield, also studied the different sizes for stills for increasing productivity of mass production. [15]. El-Sebai looked into the impact of wind speed on solar stills and came to the conclusion that higher wind speeds increase productivity because they increase Transfer by convection to heat of coefficient among the cover glass and the environment with the difference of temperature between a water with inner side of cover glass [16]. The still of the rectangular aluminum fins enclosed With a piece of black cotton cloth inside the basin, this leads to an increase in the amount of evaporation and thus improved production was examined by DwivediVK [17]. Using a water heater approach, Vinoth. Enhanced the execution of solar. In order To increase productivity [18], a one of sink single slope of solar still is used in paper to combine thermal energy of different volume of storage materials.

METHODOLOGY

Fig. 1 show Single Sink Still Solar SSSS of an sink area of 0.8 m2 have been constructed. The basin is composed of a composite of the wall made from wool of glass, wood, and stainless, it has been test using various combinations from thermal energy with different volume of storage material, including pebbles at different volume , big and small and combustion of these. For increasing the output rate from solar stills, these thermal energy of storage material combinations, weighing 700 grams apiece, are introduced. A single piece of glass that is 0.004 meters thick and tilted at a 45° angle covers the solar still. According to earlier study, a 45° tilt angle increases solar still production rate.

Figure 1 Singular solar still sink model

The material for the basin was made of many materials with a width of 4.5 cm. It is frequently utilized as a building material for things like concrete aggregate and highway construction. Table 1 displays the thermal and physical characteristics of building solar materials stills and thermal storage of material. 715

Tamil (Latitude: 9o11' N, Longitude: 77052'), experimental setup was completed and all measurements were made. The experiments were conducted in August , and readings were obtained from 9AM to 6PM under clear skies of a max. aradiation of 820 W/m^2 with an air tem. Maximum to 43°C. Every hour, a temp. of the atmosphere, the water in the solar sink, the fluid vapor in the solar still basin, the water in the outlet, also the reading of the sun's radiation are recording. The thermometers , lux meters were recorded the temperatures , solar radiations, which are then shown on various graphs. The optimal depth of 0.02 meters was chosen among the various depths of basins where experiments were to be done. Throughout the experiment, the level of a water level in sink is kept constant at a height of 2 cm.

The Results and Discussion

At 6:00 AM, the pebble has thermal energy storage was added to the solar sink. A temp. pattern in solar sink with different volume of pebbles is depicted in Fig. 2. It should be noted the addition the storage thermal energy material increases the amount of heat energy absorbed, raising the starting temperature of the water in the solar sink basin and raising the peak temperature. By mixing big and small pebbles , a maximum water temperature of 80 °C for the solar still basin was achieved. It has been noted that adding thermal storage components to solar still increases production. Table 1 shows the properties of pebbles as specific heat. Pebble has the ability to absorb heat through the today and performs well in all solar configurations. The higher of specific heat for limestone, or the basin, help to achieve before of fresh water more so than traditional materials like iron and steel.

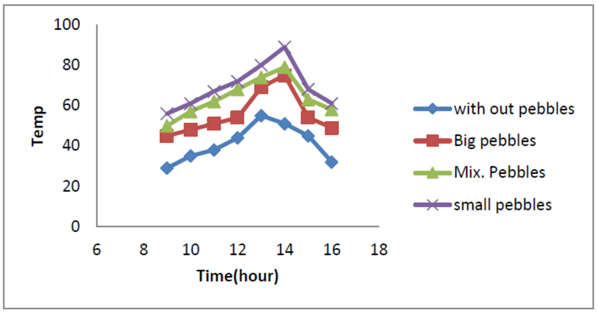

Fig.2: Water Temp. solar still sink with time

The solar still productivity for different volumes of pebbles as thermal energy storage materials is depicted in Fig. 3. During the testing time, a standard solar still is seen to produce 0.9 L, but when thermal energy storage materials like big pebbles, mixing big and small pebbles, and small pebbles are used, the solar still productivity increases as shown, respectively. 54 % more small pebbles solar still productivity was produced than with standard solar still.

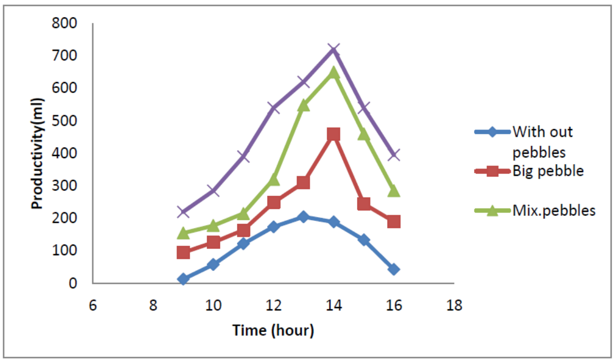

Fig.3: yield rate of different volume of pebbles

The cumulative solar yield for various energy storage of material from 9- AM to 4-PM is shown in Fig.4. Small volume of pebbles as energy storage materials combined with traditional solar technology produced the highest yield.

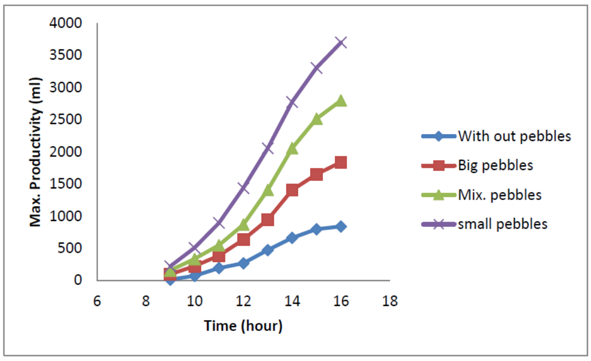

Fig.4: Max. Productivity of different volume pebble

Comparison of total daily productivity for solar still for different volume energy storage as shown in Fig. 5. Whole daily yield from a solar without storage of energy material was at its lowest, while it was highest when small volume of pebbles were combined as energy storage materials.

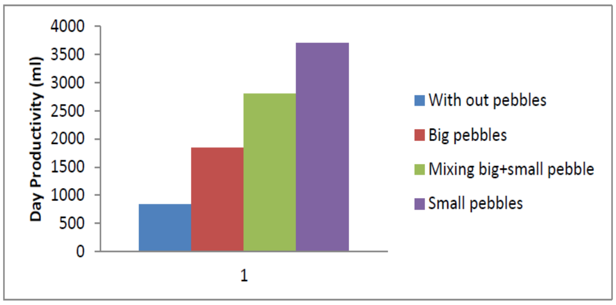

Fig.5: Day productivity of different volume pebbles

Conclusion:

A single-slope basin was made from a cover made of glass inclined at an angle of 32 degrees, and a set of tests was studied using a group of different sizes of thermal energy storage material such as pebbles, as well as an analysis and comparison of a group of different combinations of sizes of pebbles with each other small And the big. It was found that the best production of small pebbles was 3.730 liters / m 2 / per day.

References

1-Dev Rahul, Tiwari G N .Annual performance of evacuated tubular collector integrated solar still. Desalination and Water Treatment 2012;41(1–3):204–23.

2- Ahmed A. Taher, Afrah Hassoon Oraibi , Faez Abid Muslim Abd Ali , Hazim Jassim Jaber, Mechanical Properties of Graphene Oxide/Polyvinyl Chloride Composite Film, International Journal of Mechanical Engineering, Vol. 7, No. 1, 2022, pp. 669-673.

3- Dev Rahul ,Sabah A Abdul –Wahab ,Tiwari G N .Performance study of the inverted absorber solar still with water depth and total dissolved solid. Applied Energy 2011; 88:252–64.

4. Al-Akaishi, A. Salih, M.H. Alturaihi, H.J. Jaber, and A.A. Taher, "Experimental Study of

Thermal conductivity of Ag Nanofluid, Vol. 44, No. 4, Pp. 368-372, 2021.

5. A.S. Hammood, M.H.R. Al karaishi, A.A. Taher, and L.J. Habeeb, “Effect of different natural composite material lyres on structural analysis of Aircraft body,” Journal of Mechanical Engineering Research and Developments, Vol. 44, No. 5, Pp. 339-344, 2021.

6. Ahsan Amimul ,Imteaz Monzur , Rahman Ataur , Badronnisa Yusuf ,Fukuhara T. Design fabrication and performance analysis of an improved solar still. Desalination 2012;292:105–12.

7. A.T. Abdalzahra, and A.A. Taher, “A dynamic Analytical Approach to Nonlinear Stall-Spin Aircraft”, Journal of Mechanical Engineering Research and Developments, Vol. 44, No. 1, Pp. 422-434, 2021.

8. A.A. Taher, A. Mohammed, M.H. Al-Hatemmi, and H.J. Jabber, “Study rheometric, physic-mechanical properties of nitrile butadiene rubber blended with hydrogenated nitrile butadiene rubber as a model of sustainable”, Journal of Green Engineering, Vol. 11, No. 1, Pp. 29 – 38, 2021.

9- Ahmed A. Taher, Ayad M. Takhakh, Sabah M. Thahab " Experimental Study of Improvement Shear Strength and Moisture effect of PVP Adhesive Joint dy Addition PVA" 2018, Turkey,IConMEAS.

10. Reddy K S, Ravi Kumar K , O’Donovan Tadhg S , Mallick T K . Performance analysis of an evacuated multi-stage solar water desalination system . Desalination 2012;288:80–92.

11. A.H. Dhiaa, A.A. Taher, A.A. Diwan, S.M. Thahab, and R.J. Azez, “Study the thermal properties of PVP/CuNPs composite prepared by different concentrations IOP Conference Series”, Materials Science and Engineering, Vol. 870, No. 1, Pp. 012153, 2020.

12.Nafey A S , Sharaf M A ,Garcia-Rodriguez Lourdes . Anew visual library for design and simulation of solar desalination systems (SDS) .Desalination 2010;259(1–3):197–207.

13. A.A. Taher, A.M. Takhakh, and S.M. Thahab, “Experimental study of improvement shear strength and moisture effect PVP adhesive joints by addition PVA OP Conference Series”, Materials Science and Engineering, Vol. 454, No. 1, Pp. 012011, 2018.

14- Ahmed A. Taher, Ayad M. Takhakh, Sabah M. Thahab" Experimental Study And Prediction The Mechanical Properties Of Nano-Joining Composite Polymers"2018, Journal of Engineering And Applied Science, Vol 13, No 23-24.

15. Abdul Jabbar N Khalifa , Ahmad M Hamood . Performance correlations for basin type solar stills . Desalination 2009;249(1):24–8.

16. El-Sebaii A A , Ramadan M R I ,Aboul – Enein S , Salem N .The rmal performance of asingle –basin solar still in tegrated with a shallow solar pond .Energy conversion and Management 2008 ;49(10):2839–48.

17. Dwivedi V K, Tiwari G N. Comparison of internal heat transfer coefficients in passive solar stills by different the rmal models :an experimental validation. Desalination 2009;246(1–3):304–18.

18. Vinoth Kumar K , Kasturi BaiR .Performance study on solar still with enhanced condensation. Desalination2008;230(1–3):51–61.