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Effect of Heat Storage Parameters on Single Slope Stepped Solar Still Productivity

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ABSTRACT: Single basin solar still is a very simple solar device used for converting available brackish or wastewater into potable water. This device can be fabricated easily with locally available materials. The maintenance is also cheap and no skilled labor is required. This device can be a suitable solution to solve drinking water problem. Because of its low productivity, it is not popularly used. Numbers of works are undertaken to improve the productivity of the Solar still. The aim of this research has been to study the effect of various parameters on performance of single slope stepped solar still.. This Paper represents the work on solar still by using different parameters like Water Depth inside the solar still; sprinkler and various dies. In addition, how black die can increase the effective output of the solar still, sprinkler used to increase the condensation rate and lower depth of water level can increase the productivity of solar still are proved.

KEYWORDS: Solar still, wick materials, heat materials, flash evaporation

I. INTRODUCTION

More than two-third of the earth's surface is covered with water. Most of the available water is either is present as seawater or icebergs in the Polar Regions. More than 97% of the earth's water is salty; rest around 2.6% is fresh water. Less than 1% water is fresh water is within human reach. Even this small fraction is believed to be adequate to support life and vegetation on earth. Nature itself provides most of the required fresh water, through hydrological cycle. A very large-scale process of solar distillation naturally produces fresh water. The essential features of this process are thus summarized as the production of vapors above the surface of the liquids, the transport of vapors by winds, the cooling of air-vapor mixture, condensation and precipitation. This natural process is copied on a small scale in basin type solar still. Excess of brackishness causes the problem of taste, stomach problem and laxatives effects. One of the control measures includes supply of water with total dissolved solids within permissible limits of 500 PPM or less. This is accomplished by several desalination techniques like reverse osmosis, electro dialysis, vapor compression, multi stage flash evaporation and solar distillation, which are used for purification of water. Among these, the solar stills. Can be used as desalinators for such remote settlements where salty water is only one type of moisture available.[1].

Solar radiation can be used to distill and collect the drinking water; essential for daily survival both at sea and in deserts. It is lightweight, compact and easy to use. Also this important and necessary piece of survival equipment has been used by the military for many years. The high increase of the earth's population by years has resulted in a large rise demand for clean water. Added to this problem of industrial and sewage pollutants to rivers, lakes and groundwater. Solar distillation system will be one of the beneficial options for a short term solution for the

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needy arid communications facing shortage of clean water. Solar still is dependant on level of solar radiation available. This level is in turn dependent on the location, season and weather conditions. [2]

Solar stills have two important features: Technological simplicity and exploitation of a free heat source such as a sun. However, their productivity is relatively small and throughout their operational history, various attempts even via relatively complex structures have been made to enhance their performance. [3 -7].

There are many different designs of solar stills that have been used by different researchers. They can be Categorized in two systems; Passive solar still and active solar still. [7-12]. Many researchers.

II. EXPERIMENTAL ANALYSIS

Fig.1.shows the energy exchange mechanism in single basin single slope type solar still. A large part of solar radiation, direct diffused radiations are falling on the surface of solar still for performing its function to convert the brackish water into drinkable water. A small fraction of is reflected back from the glass cover the reflected back from water

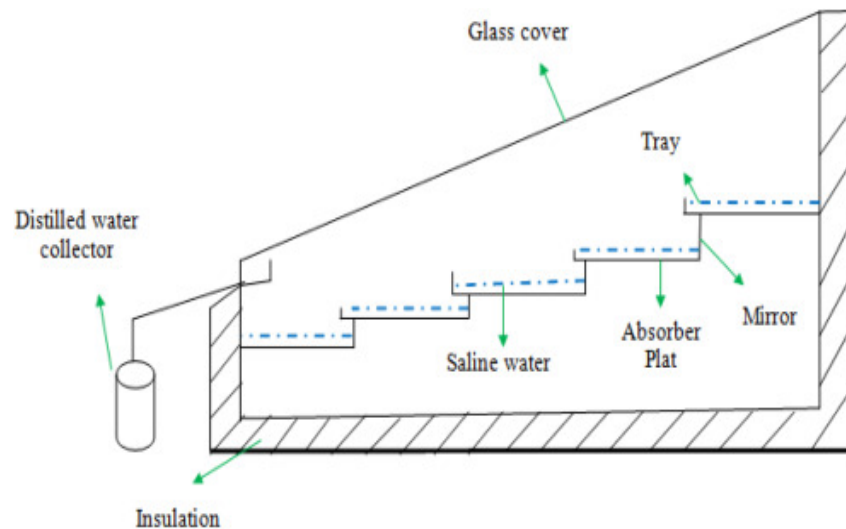


Fig.1. Energy exchange of single slope stepped solar still

The sensible heat absorbed by the water is used to evaporate the water and then transferred to glass as vapor. Another part of the heat from water is transferred to glass cover by free convection using air and remaining part by radiation. The glass transfers the heat to atmosphere by convection and radiation.[19]. Fig.1 shows the energy exchange mechanism of single slope solar still.

III. EXPERIMENTAL SET UP

The stepped basin sun powered still has compelling bowl territory of 1m x 1m and created out of hardened steel material. The base of the still painted with dark by blending an uncommon dark color with tar. A window glass of 3 mm thickness slanted at slanted at 300 whenever fixed to the vertical mass of the still. To guarantee that vapors are not lost environment, the glass spread fixed with the elastic gasket. A bay pipe gave at the back mass of the still to bolster water. As pipe was associated with channel to deplete the new water to bottle. Restricted necked plastic jugs used to gather the refined water. A 100 ml served to characterize the half-hourly refined yield. For the test on sunlight based as yet, following instruments were utilized.

1. A separate gap is penetrated in the collection of still to fix copper constantan thermocouples to detect the glass spread and bowl water temperature.

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2. A advanced temperature pointer gave the temperature estimations in the scope of 0-200⁰C with a precision of 0.10C.
3. A fluid in glass thermometer, utilizing liquor, estimated the surrounding temperature.
4. A pyranometer has been utilized to gauge the sunlight based power. It is computerized type and can quantify in the scope of 1- 100mW/cm² sunlight based power with an exactness of 2 mW/cm²
- 5.



Fig.2. Experimental set up of stepped basin solar still

The single basin solar still has effective basin area of 1m x 1m and fabricated out of stainless steel material. The bottom of the still painted with black by mixing a special black dye with resin. A window glass of 3 mm thickness inclined at inclined at 30⁰ if fixed to the vertical wall of the still. To ensure that vapors are not lost atmosphere, the glass cover sealed with the rubber gasket. An inlet pipe provided at the rear wall of the still for feeding water.

6. Technical specification:

Temperature of Glass Cover:

In this work, different thicknesses glass covers were used like 3 mm, 5 mm and 8-mm. Major aim was to find optimum thickness of glass cover.

Insulating material

Insulating materials used to reduce the heat loss from bottom, top, and sidewall of still and to make constant temperature inside the solar still. The insulating material is rock wool and it was surrounded by charcoal to increase the temperature inside the still. Here, rock wool and charcoal used as insulating materials.

Angle of glass Cover:

Angle of glass cover has significant effect on performance of solar still. has taken experiment on solar still and found that there is a significant effect on performance of solar still. Angle of glass cover has also remarkable effect on performance. Optimum glass cover angle increase the condensation rate because slope is improved and speed of distilled water output is increased. Higher angle of slope reduces the condensation rate.

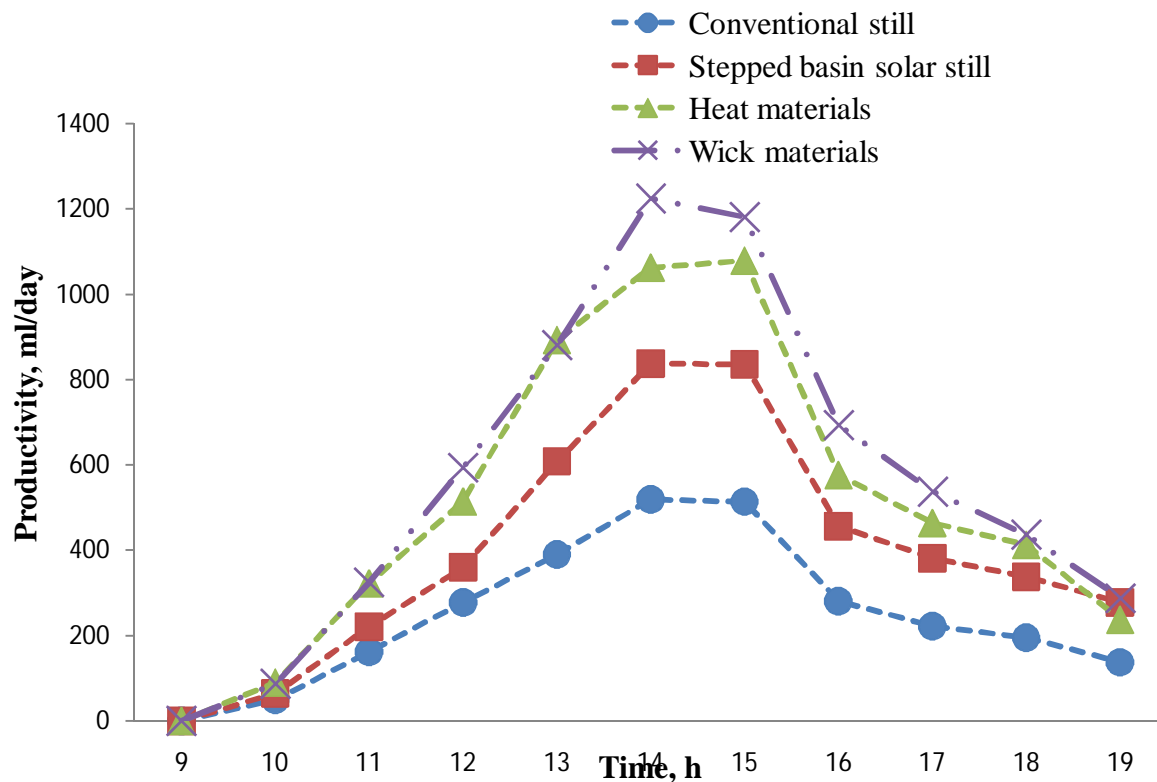
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IV. RESULT AND DISCUSSION



4.1 Basin Liner:

This is a major part of solar still. Because it absorbs the radiations from the sun, so heating of water is produced and Vapour is formed. Basin should be resistant of hot water and it has high absorptivity. It should be such that when radiation intensity high, so puncture is not produced. Two different basin liners were used to increase the absorptivity, such as surrounded by FRP and Black paint.

Specifications	Dimensions
Basin Area	1 m ²
Glass Area	1 m ²
Number of Glass	1
Slope of Glass	30
Insulation Thickness	0.5 m
Glass Thickness	5 mm
Angle of glass cover	15 degree

Table.1 Dimension for stepped solar still

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4.2 Relation between various temperatures vs. Time (Hr)

Fig.4. show different measured temperatures by providing thermocouples. Here we can say the maximum temperature that can be achieving this is temperature of Water. When solar rays are directed on the sun rays, so it will heat and due to heating of the water temperature is increased and lowest temperature is achieved at upper glass temperature. Because if it will increase then distilled water will not stick to the surface of the glass and due to improper sticking of the water, then water will dropped inside the still and productivity is decreased.

T _{ug} (°C)	T _{lg} (°C)	T _{wu} (°C)	T _{wl} (°C)	P (ml/h)	P (ml/h)	P (ml/h)
				U	L	T=U+L
36	34	45	44	0	0	0
44	40	62	60	210	150	360
47	42	74	73	340	230	570
50	44	79	77	540	360	900
53	46	81	78	570	380	950
51	44	78	76	500	340	840
48	42	73	69	400	270	670
42	39	66	62	350	240	590
40	38	62	58	210	140	350
35	32	51	49	120	90	210
34	31	45	44	50	30	80

Heat capacity is very important in solar still. It can be defined as amount of heat stored by the material. Due to increased in heat capacity of solar still, there is a problem for the distilled output. Because distilled output was decreased. So by using sprinkler (Cooling Film) maintained between inner glass and outer glass, there is not loss of heat and distilled output is increased. Fig.5 shows the relationship between time and distilled output with use of sprinkler, by use of cooling coil or sprinkler. Sprinkler is very important because it increases the condensation rate or water sticking rate inside the glass cover and due to increase in sticking of water on glass cover more amount of distilled output.

Use of sprinkler or providing water at inner glass also used to improve the distilled output. From the figure, it is evident that the productivity decreases with increase of water depth. This increases in still distilled output as depth decreases could be attributed to the lower heat capacity of basin water that results

V. CONCLUSION

1. An experiment work has been conducted to predict the distilled output of water from the single slope solar still using different parameters.
2. It is very interesting to note that the less depth of water can increase the distilled output by even evaporation as well as uniform distribution of water.

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3. Heat storage materials is a good material to increase the condensation rate of the water and increase the distilled output and at last black die is a best die to increase the absorptivity of water and increase the evaporation rate of the water inside the solar still.

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