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Performance Analysis of Solar Stills with Different Absorbing Materials

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Abstract*: *Water is the fundamental need of humanity. The consumption of water is rising with each day. The major parts of the available water, i.e. 97%, are saline seawater and 2% is ice and glaze. Just 1% of the water is pure drinking water. Therefore in order to satisfy the demand for fresh water, it is important to turn the impurity of salty sea water or brackish water into pure water. The Solar Single Slope Single Basin (SSSB) is not being experimentally investigated. The experimentation was performed during the months of May and June 2020 under Indian climatic conditions. The efficiency of still cotton cloth with marbles and jute cloth with marbles is 50.00 per cent and 46.15 per cent respectively, higher than average.

Keywords*: *Solar radiation, Solarimeter, Cotton and Jute wick, Solar still.

I. INTRODUCTION

Water, energy and the environment remain critical elements for the ecological growth of individuals and are thus rightly referred to as life support systems. In many countries around the world, fresh water is increasingly becoming a scarce resource. Although most accessible as a result of anthropogenic activities, there have been periods which has to be removed from adulterated water generally salt water. Several inhospitable desert and semi-arid countries are taking scarcity of treated wastewater from dietary origin.The desalinated sea water is the main source of drinking water in those countries. The developing nations are taking steps to find good potable water due to the increase in the population combined with the growth of industrial and agricultural sector. There is however, a discrepancy between available water supplies and consumption due to a shortage of drinking water. Abdulrahman et al. [1] carried out experiments in four solar-type basin stills. Three stills used to have a mirror thickness of 3 mm, 5 mm, 6 mm, whereas the remaining remained acrylic. The slimmest reflector recorded the maximum productivity levels, up by 15.5 per cent. Valsaraj[2] carried out experimentation in a single slope solar reservoir still after the introduction of a submerged corrugated and rolled aluminium sheet on the water surface. Owing to the amendments proposed, the efficiency of the single slope solar basin is still increased. Phadatare et al. [3] have examined the impact of deep water on inner thermal convection in a single reservoir of tape dispenser solar still. The findings have shown all this with the rise in water depth, sunlight performance of still is decreasing. Velmurugan et al. [4] have carried out experiments in step-by-step solar still retaining a minimal water depth. Analytical and empirical research was carried out for the form of fin, the sort of substrate and the variation of the fin and the form of substrate still in the solar phase. Velmurugan et al. [5] have rendered an effort to increase the efficiency of solar stills by linking a miniature solar pond and an individual solar pond still in sequence. Murugavel et al. [6] performed experimentation in a double-sided solar basin still using various hose substances. The water column with hose substance in the basin would improve the evaporative cooling effect and improve efficiency. Once the fin and sponge form were still in usage, productivity improved by 80 per cent compared to the usual single solar basin. Minasian et al. [7] have established a wick-type still and a standard still that are linked and established as a single entity. The wicks contain water through capillarity. Kabeel[8] carried out still pyramid-shaped developmental experiments. The curved wick surface has been used for evapotranspiration and the outer layers of the pyramid still formed have been used for distillation process. Mahdi et al. [9] developed and made a tilted wick kind still. Acrylic cloth has been used as a wick product. It has been observed that the performance of the wick form continues to decline as a result in the input water mass flow rate. In the experimental research, tests were performed on single basin solar stills (SBSS) in various wicks (cotton cloth and jute cloth) on the internal surface of the basin. Khalifa et al. [10] investigated the impact of insulation on the efficiency of solar stills. Test was carried out on four stills via an insulation of 30 mm, 60 mm, 100 mm and the last still without insulated. Rehim et al. [11] carried out an experimental study in the solar system with two adjustments. The very first was to get a loaded layer that's been mounted in the streambed to make it even more effective.

II. EXPERIMENTAL SET-UP

Experiments were conducted in a still at the Sachdeva Institute of Technology, (27.4924° N, 77.6737° E) Uttar Pradesh, India. The trials were performed in the periods of May and June 2020. The scale of the basin was 0.5 m x 0.5 m x 0.15 m. Normal glass windows with a thickness of 3 mm have been used as transparent covers. The wraps remained angled at an optimal angle of 270 with a fixed point.

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Thermocolumn with a thickness of 5 mm has been used as covering. The trials have been carried out with three distinct wick fabrics, like cotton cloth and jute cloth. The wicks are repainted to enhance absorption. The efficiency of the two wick stills were contrasted to that of the traditional stills.

The wicks were attached to all the inner surface of the still basin. Experimentation was also performed with wicks and marbles in the basin. The diameter of used marbles varies from 20 to 30 mm. The weight of the marbles used is 1 kg for all tests. Storage gullies were supplied at the base to store the filtrate. Amendments have also been provided for the distribution of salt water, the drainage of the evaporation rate and the use of temperature sensors. Figure 1 displays the still photograph version. Figure 2 shows the view on jute fabric, black cotton and pebbles.

Fig. 1. Experimental Setup of Still

Fig. 2. Photographic view of jute cloth, black cotton and pebbles

III. WORKING PRINCIPLE

Desalination process utilizes the warmth of the sun explicitly in a small piece of water purification apparatus. The machinery, generally referred as a solar still, makes up the bulk of a small basin with a clear glass cover. The sun warms the water in the reservoir, triggering evaporation. Condensation grows, disperses on the covering and flows back into the trough, bringing aside salts, minerals, and whatever other contaminants, even pathogens. While it may be very costly to create a solar still that is both powerful and light as possible, it can generate filtered water at a fair cost if it is made correctly, controlled and managed.

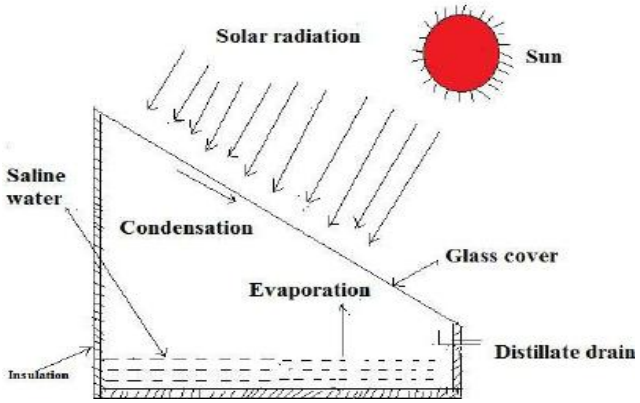

Fig. 3. Basic Principle of Solar Still

IV. RESULTS AND DISCUSSIONS

First experiment has been done on 24th May 2020 on single slope solar still without materials, there are following temperatures of Bottom, Glass and Water were recorded as shown in fig.4.

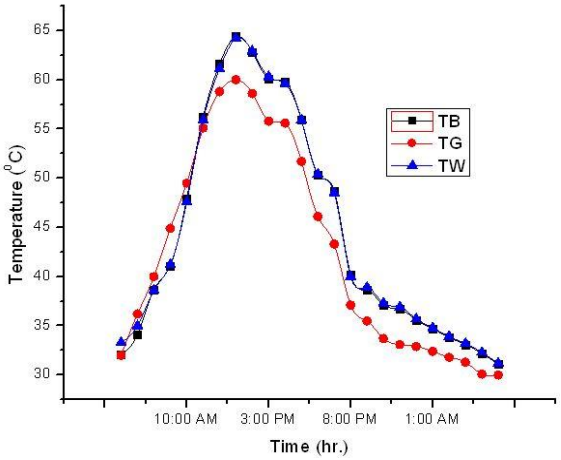

Fig. 4. Temperature of bottom, glass and water on 24th May 2020

Just at completion of the 24-hour cycle, the result of produced still water being evaluated, 350 ml of distilled water was obtained from 8 litres of stagnant water in 24 hours. The next experiment was carried out on 26 May 2020 on single-slope solar still using black cotton wick, with temperatures below Bottom, Glass and Water reported as shown in fig.5. Also at conclusion of the 24-hour trial, the product of the produced still water being evaluated, 575 ml of still water being retrieved from 8 litres of stagnant water in 24 hours.

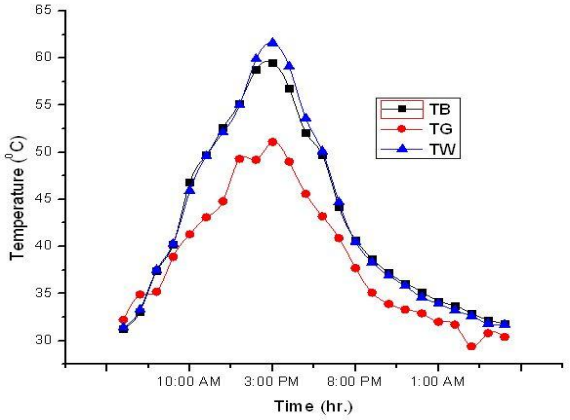

Fig. 5. Temperature of bottom, glass and water on 26th May 2020 (with black cotton)

Third experiment has been done on 28th May 2020 on single slope solar still using jute wick, there are following temperatures of Bottom, Glass and Water were recorded as shown in fig.6. Only at conclusion of the 24-hour trial, the product of the produced still water being evaluated, 550 ml of still water being retrieved from 8 litres of stagnant water in 24 hours.

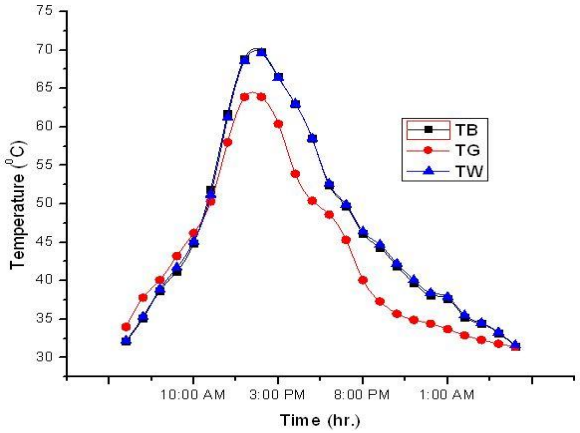

Fig. 6. Temperature of bottom, glass and water on 28th May 2020 (with jute)

Forth experiment has been done on 30th May 2020 on single slope solar still using cotton cloth with pebbles, there are following temperatures of Bottom, Glass and Water were recorded as shown in fig.7. Just at conclusion of the 24-hour trial, the product of produced still water being evaluated, 700 ml of still water being retrieved from 8 litres of stagnant water in 24 hours.

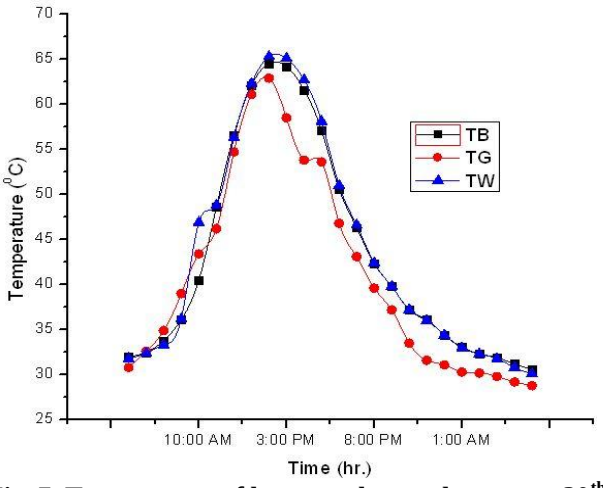

Fig. 7. Temperature of bottom, glass and water on 30th May 2020 (with cotton cloth with pebbles)

Fifth experiment has been done on 02th June 2020 on single slope solar still using jute cloth with pebbles, there are following temperatures of Bottom, Glass and Water were recorded as shown in fig.8. Just at conclusion of the 24-hour trial, the product of the produced still water being evaluated, 650 ml of still water being retrieved from 8 litres of stagnant water in 24 hours.

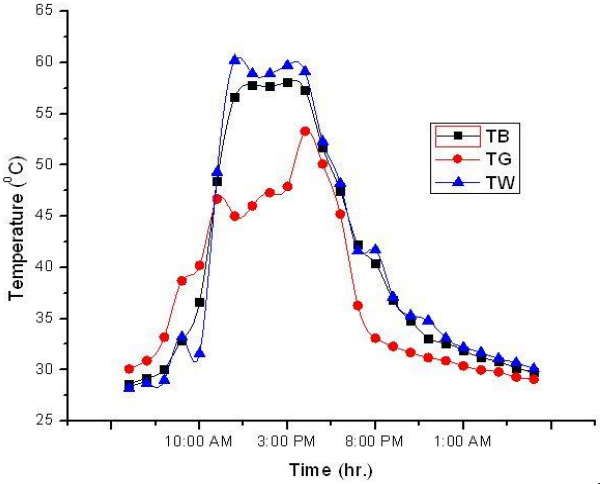

Fig. 7. Temperature of bottom, glass and water on 30th May 2020 (with jute cloth with pebbles)

V. CONCLUSION

Four SBSS solar stills are being manufactured and whose efficiency has been contrasted to numerous basin situations. The main findings shall be drawn:

- The supply of various wicks on the internal surface of the basin improves performance.
- The performance of cotton cloth and jute cloth is 39.13 per cent and 36.36 per cent respectively, higher than traditional cloth.
- The performance of still cloth with marbles and jute cloth with marbles is 50.00 per cent and 46.15 per cent respectively, higher than traditional still.

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