Research Paper Engineering

Single Slope Single Basin Solar Still Integrating With Wind Turbine and Incline Solar Still

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ABSTRACT

Water desalination process is one of these methods used to resolve the scarcity of fresh water. The solar still can be used for heating as well as desalination purpose .The Intent of the present study aims to increase productivity of solar still so it is necessary to modify it. This paper presents a new fabricated desalination system that constitutes of wind turbine (WT) and inclined solar water desalination (ISWD) integrated with main solar still (MSS). The new developed system is fabricated and evaluated under actual environmental conditions. A small wind turbine is used to operate a rotating shaft fitted in the MSS to break boundary layer of the basin water surface. Also, an ISWD system which consists of an inclined flat solar absorber plate covered with black-wick medium is attached to the exit of MSS. The system can produce distilled and hot water. The heating and evaporating processes take place in MSS as well as ISWD, and then the water are condensing on the glass covers. This system is test at different water depths, different water flow rates and two modes of operation as due south and tracking the sun. Variation of ambient conditions, and water temperatures and outputs were used to evaluate each parameter. The distilled water quality as well as hot remaining water is good enough for domestic usage.

Keywords : Wind Turbine, Solar Still, Water Desalination, Hot Water

NOMENCLATURE

η Thermal efficiency
τ Transmitivity of glass
α Absorbtivity of glass cover
I Solar radiation, W/m^2

INTRODUCTION

The use of solar energy is more economical than the use of fossil fuels in remote areas having low population densities, low rain fall and abundant available solar energy.

Desalination of brackish or saline water, wherever it is available, is a good method to obtain fresh water.

However, the conventional distillation processes such as Multi-effect evaporation, Multi stage flash evaporation, thin film distillation, reverse osmosis and electro dialysis are energy intensive techniques, and are the feasible for large stage water demands. Therefore, solar distillation is an attractive alternative because of its simple technology; non-requirement of highly skilled worker for maintenance work and low energy consumption.

Desalination has become increasingly important in providing an economically viable solution to the problem of decreasing fresh water resources.

The basic principles of solar water desalination are simple, yet effective, as desalination replicates the way nature purifies water. The sun's energy heats water to the point of evaporation. As the water evaporates, water vapor rises, condensing on the glass surface for collection. This process removes impurities such as salts and heavy metals, and destroys microbiological organisms. The end result is water cleaner than the purest rain water.

In this recent paper we are going to take a look on the single slope single basin solar still, This device can be fabricated easily with locally available materials. The maintenance is also cheap and no skilled labor is required. Numbers of works are undertaken to improve the productivity of the still. In this work progresses in the works done on single basin still to improve its productivity are reviewed.

The orientation and inclination are optimized to receive maximum radiation and lower the condensation loss. Different materials are used in the basin along with water to improve the heat capacity, radiation absorption capacity and enhance the evaporation rate. The effect of varying the depth of the basin water is also studied.

LITERATURE SURVEY ON SINGLE SLOPE SINGLE BASIN SOLAR STILL:

[1] Y.P.Yadav in (2000) By Their Performance analysis is presented of a basin-type solar still coupled to a tubular solar energy collector. Explicit expressions are derived for the water temperature, The yield and overall efficiency of the system as a function of time, collector's and the still's parameters.

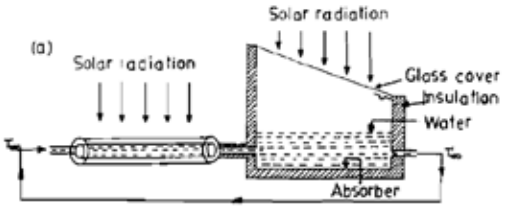


Figure1. Schematic diagram of a solar still integrated with a Tubular Solar Energy Collector

Effects of length of the collector and flow velocity have been studied on the yield and overall efficiency the solar still.

The daily distillate output increases with increase collector length while decreases with increase flow velocity.

[2] B. A. K. ABU-HIJLEH et al. in (2001) They performed that a solar still with different size screens placed in the basin was studied experimentally. The increase in daily production of the still was 11% to 13% compared with an identical still without screens under the same conditions.

The use of screen(s) in the basin water resulted in a significant improvement in still production. The use of a screen and dye complemented each other. At dye concentration of 0.5ml ink/L water, the dye accounted for 19% of the total 59% increase in still production for the case of still with screen and dye.

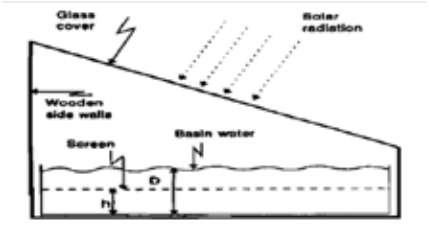


Figure 2 Schematic view of solar still with screen in the basin

Changing the still side wall color from the original natural wood color to black colored side walls and then to silver colored side walls color resulted in a further 10% and 20% increase in improvement ratio.

[3] M. Boukar, A. Harmim in (2001) Their research has been to study the effect of desert climatic conditions on the performance of a simple basin solar still and a similar one coupled to a flat plate solar collector. The performance of the simple still is compared with the coupled one.

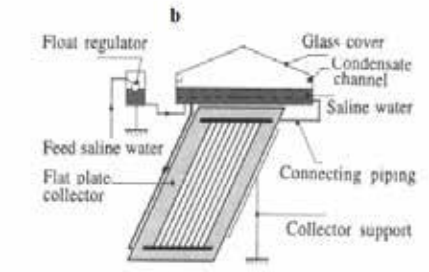


Figure 3 Solar still coupled with collector

They were tested for all day productivity under clear sky conditions

The daily still productivity in summer period varies from 4.01 to 4.34 l/m²/d for simple basin solar still and from 8.02 to 8.07 l/m²/d for the coupled one.

It is observed that the coupled still gives maximum yield at all depth of basin water but not the simple still.

[4] Hiroshi Tanaka, Yasuhito Nakatake in (2003): They investigate a newly designed, compact multiple-effect diffusion-type solar still consisting of a heat-pipe solar collector and a number of vertical parallel partitions in contact with saline-soaked wicks.

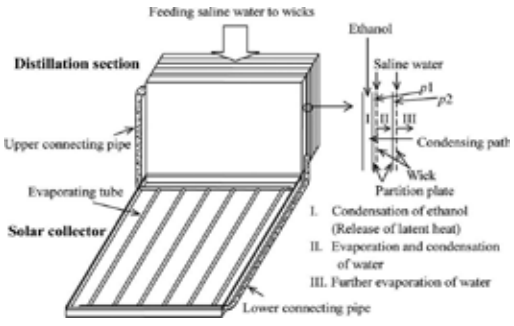


Figure 6. Schematic diagram of multiple-effect diffusion type still coupled with solar collector.

The performance of the proposed still is analyzed theoretically, and the still is predicted to produce 21.8 kg/m2d distilled water on a sunny autumn equinox day of 22.4 MJ/m2d solar radiations, and the productivity is greater than that of a vertical multiple-effect diffusion-type still coupled with bulky basin type still.

[5] G. N. TIWARI ET AL. in (2007): In this paper, thermal models of all types of solar collector-integrated active solar stills are developed based on basic energy balance equations in terms of inner and outer glass temperatures. The overall thermal efficiency of active solar still integrated with FPC, concentrating collector, ETC and ETC with heat pipe is 13.14, 17.57, 17.22 and 18.26%, respectively.

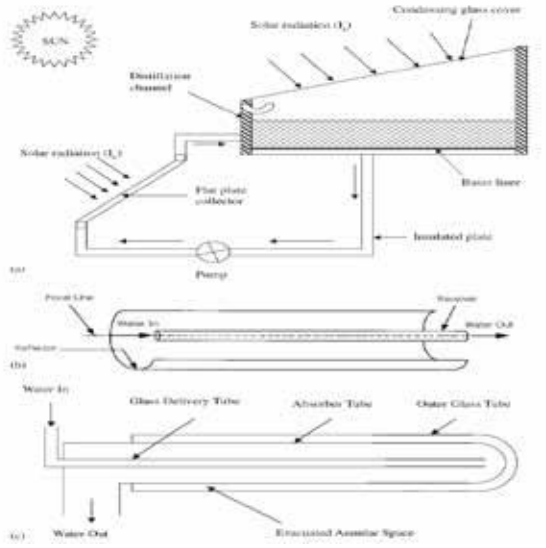


Figure 3. (a) Schematic view of an active solar still coupled with a flat plate collector; (b) cylindrical concentrating collector; and (c) schematic diagram of Owens Illinois (OI) evacuated tube collector.

[6] K. Kalidasa Murugavel et al.in (2008) They investigates that The orientation and inclination are optimized to receive maximum radiation and lower the condensation loss. The effect of varying the depth of the basin water is also studied. The orientation of the glass cover depends on the latitude of the place. For northern latitude south facing and southern latitude north facing stills are used.

For lower latitude places double slope stills are preferred with south–north orientation.

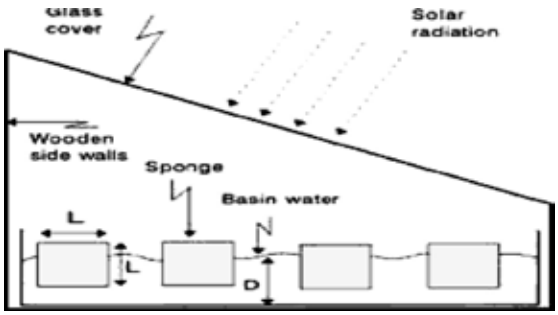


Figure 4: Solar still with sponge in the basin

The day-time and night-time productivity greatly depends on depth of water and heat capacity of the basin. For lower sun radiation intensity places shallow basin still is preferable. For higher sun radiation intensity places deep basin still is preferable to improve nocturnal production.

[7] S.G. Patel et al. in (2006) They investigates and shows that To enhance the overall efficiency of conventional basin

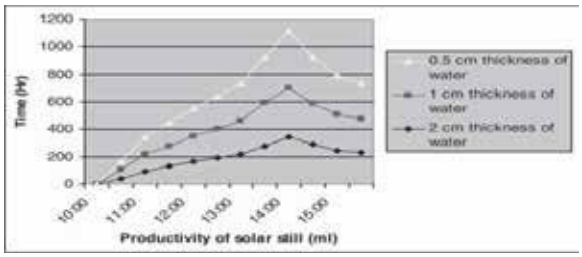
type solar still, Different semi-conducting oxides like CuO, PbO2,MnO2 have been utilized as photo catalysts.

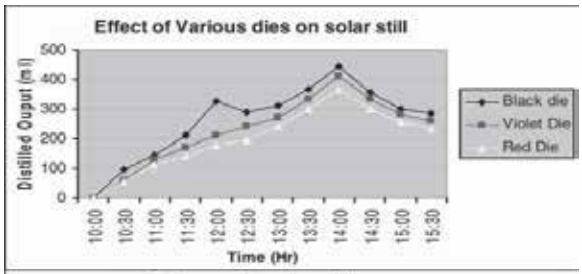
It is observed that metal oxides not only improve the efficiency of the process but The rate of production of desalinated water was also increased to a remarkable extent.

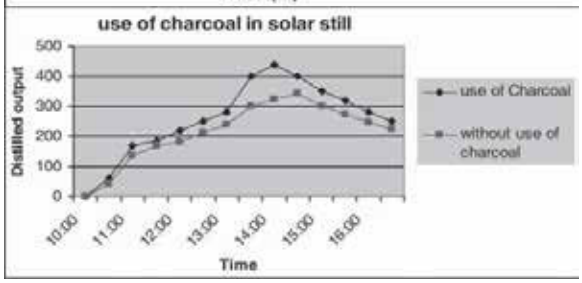
Conductivity of raw water is reduced using metal oxides and in particular, PbO2 is most effective among the three oxides used.

[8] HITESH N PANCHAL et al. in (2010) (International Journal of Innovations in Electrical Power Systems):-

This paper represents the work has been done on Passive solar still to improve the productivity. In Passive solar still improvement in different parameters like cover plate, water depth, and basin area are examined.







Rubber, gravel, saw dust and sponge cubes are good material to store the solar energy and increase the productivity.

The orientation of glass cover is very important for increase in productivity. Hence, north latitude places south facing glass cover should be used and south latitude places north facing glass cover should be used.

Glass is most suitable material for the solar still cover because of higher transmittance and higher thermal conductivity.

PROBLEM DEFINATION

The efficiency of the solar still basin depends upon the temperature difference between glass cover and basin, Rate of evaporation and condensation in the basin and heat loses into the surrounding

We can increase the rate of water vaporization in the basin with adding wind turbine with main solar still which is rotating in the basin and break the boundary layer of basin water surface and an Incline solar water desalination system which consists of an inclined flat solar absorber plate covered with black-wick medium is attached to the exit of Main solar still The system can produce distilled and hot water.

There are number of works found on solar still in different way and using different materials like Rubber, gravel, saw dust and sponge cubes black and collector to enhance the rate of evaporation and condensation and their distillated water production. From the literature survey it is observed that only few have attempted working with single-slope solar still using some type of integration with it

CONCLUSION:

This paper identifies the advantages of the modified single slope single basin solar still

The distilled water output of solar still is mainly depends on such parameters like rate of evaporation and condensation of basin water, temperature difference between glass cover and basin and heat transfer capacity.

In the simple solar still adding a wind turbine and incline solar still with main solar still basin and try to improve the rate of evaporation and condensation and try to getting a better reflection in improvement of distilled water production.

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