

Effect of Different Brackish Water Depths on the Performance of a Solar Still

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Abstract— Water is essential to life. The supply of drinking water is becoming an increasingly important issue in many areas of the world especially. In remote and arid areas in Algeria and world. Among the non-conventional methods to desalinate brackish water or sea water, is solar distillation. The present study aims to improve the solar still performance, and to increase its productivity. So it is necessary to evaluate some important parameters affecting the system productivity. The effect of water depth in the basin on the water productivity was evaluated. In the same time, Desalination process were investigated. Different depths of brackish water (1cm, 2cm and 3cm). The optimal brine water depths 1cm and productivity 3530 ml/m².

Keywords—Solar still, depth water, brackish water, productivity fresh water.

I. INTRODUCTION

Water is the main requirement for life. Because the amount of the available freshwater is limited, and because of population increase and industrial development. [1]. More than 97% of the earth's water is salty and around 2.6% water is fresh water. Uneven distribution of fresh water is such that less than 1% fresh water is within human reach [2]. So, the accessibility to drinking water is one of the main problems for human being in arid remote areas all over the world [3], recently, global water consumption levels increased dramatically, reaching or exceeding the limits of renewable water resources in some areas, especially in the Middle East and North African countries. In these places, the existing freshwater resources are under heavy threat from overexploitation, pollution and global warming [4] the need for freshwater is increased Water desalination using solar energy is one of the methods to get potable freshwater from saline water. One of the well-known attractive and simple solar distillation techniques is solar stills. [5]. solar stills were the first method which was used on a small scale to convert impure saline water to potable water. In the year 1872 in Las Salines, Chile, Carlos Wilson, a Swedish engineer supplied fresh water to workers at a salt peter and silver mine by the process of solar desalination. To fulfill this requirement by using solar energy for decontamination of brackish or brine water is really a boon for all humankind because of its simple technology, non-requirement of highly skilled labor for maintenance and low energy consumptions. [6]. Solar still uses the solar energy to purify saline or contaminated water using principle of distillation. [7]. This paper provides a study dealing with distillation for isolated

low-density population areas using solar energy .three single basin single slope solar stills were fabricated and the experiments were conducted to compare the performance different water depths in the same location and radiation conditions simultaneously.

II. EXPERIMENTAL SETUP

Three basin stills prototypes of simple single-slope solar distillers were built at the laboratory for the development of new and renewable energies in arid and Saharan areas (LENREZA) / Faculty of Mathematics and Subject Sciences / Kasdi Merbah University of Ouargla, ALGERIA Latitude: (31°57 North, Longitude: 5 ° 19 East) the experiment are carried out period from Avril 2018 .

Three basin stills different depth of water 1cm, 2cm and 3cm with the same size were used to evaluate the solar desalination system performance. A photograph of a solar desalination setup are shown in Figs. 1.



Fig. 1. Photograph of a solar desalination setup

The distillers used in our experiments. They have the same dimensions, Each distiller consists of A wooden support as insulation for the distiller, it has a thickness of 0.04 m; A glass cover (the glass) on the inner side of which, is carried out the condensation of water, it has the following dimensions: 0,41 m × 0,75 m, its thickness is 0,003 m, it is inclined with respect to the horizon of an angle of 30 ° A metal basin in which the evaporation takes place. It has the following dimensions: 0,05 m × 0,40 m × 0,60 m, it is made of galvanized steel with a thickness of 0,004 m - A channel for the recovery of distilled water which is at the level of the

wooden cover and which is bound by a plastic tube to separately recover the distilled water outside the distiller.

The chosen insulation is polystyrene covering the absorbent to reduce heat loss, its thickness is 0.03 m; Pipes These are plastic pipes, with a diameter of 10 to 15 mm to bind the different parts of the distiller to transport brackish or distilled water; Graduated cylinders: These are graduated tubes used for measuring the volume of distilled water.

The amount of distilled water was measured at hourly intervals. The temperatures were measured using type K thermocouples. The wind speed was monitored using a [NI Compact DAQ USB Chassis](#). The solar intensity was measured by a pyrometer with integrator (Kipp & zonen B.V., pyrometer model CMP 3).

Experiments are conducted at the University of applied science Ouargla, Algeria during the period from 9 am to 6 pm of Avril 2018 The air temperature, solar radiation, brackish water, and distilled water are measured every 1 h.

III. RESULTS AND DISCUSSION

Productivity vs Time with various depths of water for a solar still, Graphs are drawn for Productivity and Time for different depths of water level 1cm, 2cm and 3cm It reveals an increase in the productivity for minimum depths of water level. The higher the productivity as shown in the. The amount of basin water is large when using higher water depths and hence, it needs more time to be heated and generates evaporated water (vapors) fig2.

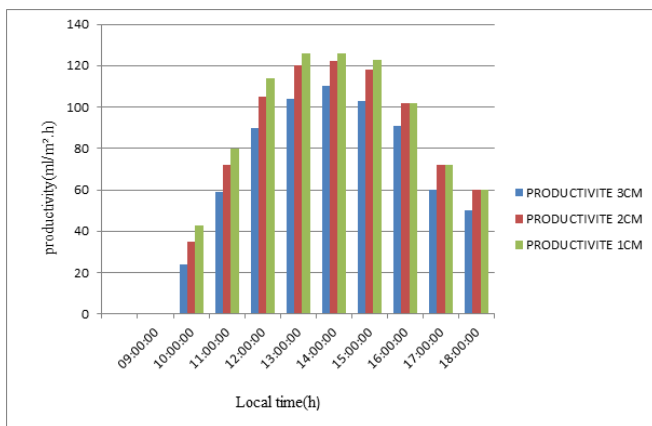


Fig. 2. Productivity vs Time with various depths of water

As shown, Fig. 3 displays measured ambient temperature and solar irradiance versus local time for our experiment location. During our experiments, ambient temperature monitored was between 26 °C at 9:00 h and 38 °C at 14:00 h. Solar irradiance increases in the first half of the day and reaches its maximum value between 12:00 and 14:00, before it start to decrease in the afternoon. The maximum value recorded was 991 W/m² at 13:00 h local time

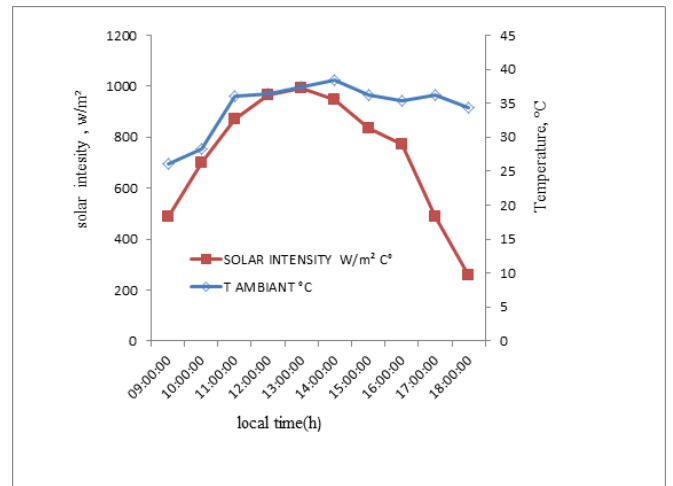


Fig. 3. Variation of ambient temperature and solar irradiation

Fig. 4 displays typical measured temperature–time history curves of still with 1cm as an example

Define Almost all temperature curves in all of stills follow the same trend as the solar irradiance. All of still temperatures reach their maximum values at 12:00 h.

The highest temperature recorded for the still is that of the mixed vapor and air trapped inside the distiller (Tai), because of the greenhouse effect and the overheating caused by the latent heat of vapor condensation. The maximum value recorded for this temperature was 68.08 °C .T vapor.

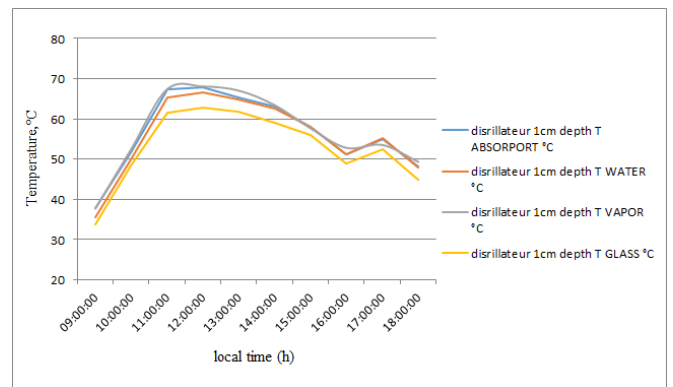


Fig. 4. Variation of temperatures's still with 1 cm depth water

IV. CONCLUSION

The major interesting results of the present work can be summarized in the following points:

- The possibility of increasing the water productivity could be reached by lowering the water depths on the basin- absorbing plate. It is necessary to investigate the effect of all the operation parameters before taking the decision of installing The maximum increase of modified water depths still productivity is during the daytime at a brine water depth of 1 cm. gives 3530 ml/m² of fresh Water. the solar distillation plant
- The accepted thermal performance of the constructed solar still with an increased evaporation rate and the faster condensation was achieved due to the

appreciated contribution of the improved design parameters and the operational.

- The deciding contribution of using solar still a glass and role of cooling the glass cover was strongly observed on the increased temperature difference ($T_w - T_g$) as well as on the increased water productivity. Higher attention must be spent to the times of applying the cooling method.
- It was found that the geographical location may having a significant positive effect on the increased water productivity, especially for those locations with an abundant solar irradiation.

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