Increase the yield of simple solar distillation using the water drip method

Wissam H. Alawee, Hayder A. Dhahad, Khaleel I Abass

Abstract— **The need for clean drinking water is increasing daily with the increase in the population and the high standard of living. A large part of the world's energy is spent on drinking water and this energy comes from fossil fuels. The burning of fossil fuels is close to depletion and causes major environmental problems, including global warming and climate change. The use of solar energy to produce potable water is an excellent alternative and can be relied upon using solar distillers, which are simple to configure and cost-effective and have proved their potential and relied on by many peoples for centuries.**

The design and construction of a solar distiller based on the method of water dripping on a hot surface to obtain rapid evaporation with a large area of condensation. The efficiency of this distillation was compared to a simple mono-millimeter pump designed for this purpose. The results showed that the proposed distillation yields greater yield than the simple distillate. Adding reflectors to concentrate the solar radiation all the time on the distiller resulted in an increase in distillate yield of up to 14%.

***Index Terms*— distiller, drip method, productivity, evaporation, condensation**

I. Introduction

Although three quarters of the globe's surface is covered by water, many areas of the world suffer from a clear shortage of water suitable for human consumption [1]. Only 3% of water of this amount is beneficial, not all drinkable, according to the International Water Bulletin In 2003, and that the most water available on the surface of the earth is salt water [2]. Therefore, we find that the scarcity of potable water and human uses is considered a problem of the current age facing the world, especially countries that lack fresh water resources such as rivers, springs and wells [3]. The long dry seasons are characterized by low rainfall and the desert crawling into large areas of agricultural land, which suffer from clear salinity that is difficult to use for human use [4]. That many of the countries of the world are suffering from freshwater in the present time and spend large amounts of money to obtain water desalinated for human consumption, estimated at about 30 billion dollars a year for access to this water, according to reports of the United Nations [5].

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The world's problems due to global warming, pollution of the environment and climate change and its impact on human health due to the harmful gases caused by the burning of oil and coal require the tendency to avoid the burning of petrochemical fuel in many areas and confined in the petrochemical industries and replace them with solar energy [6]. Also, that solar energy enormous energy if properly exploited could meet many of the requirements of human energy, and as clean energy without exhaust we could preserve the human environment and reduce the global warming of the atmosphere [7]. It can be argued that the interest in research that leads to the provision of fresh drinking water [8, 9]. More emphasis on its development can be directed to research the increase in the performance and productivity of solar distillates and drought-powered water to obtain fresh water from unsafe water [10, 11]. If we know that the cost of freshwater transfer to these areas are expensive and require maintenance, pumping capacity and storage [12]. The chemical and electrical methods of distillation require high technical costs and cannot be used in poor countries and remote places [13, 14]. Therefore, the idea of developing solar distillates has emerged in different parts of the world, especially in southern Iraq, where there is high saline water and a period of solar brightness of 80% of the total time of sunrise [15-17].
Water shortage is a problem that disturbs the world and the alternative will be the solar water desalination [18, 19]. It is light and heat emitted from the sun that have been used by man for his benefit since ancient times using a variety of technologies that are constantly evolving and include techniques to harness solar energy using the energy of the sun for direct heating or conversion process mechanic by the use of cell panels [20-22]. The sun is the origin of all sources of energy on the surface of the Earth and is the main source of heat and due to the emergence of all other energies on the surface of the earth to the sun, wind energy from the temperature difference on talking land as well as with water source waterfalls and rain that comes from the natural water cycle caused by the sun [23-26]. Also, it is the cause of coal and oil formation in the bottom of the earth [27]. What distinguishes solar energy from other types of renewable energies that it is enormous [28]. If it is properly exploited, the consumption of tons of fuel and the consumption of a lot of electricity cannot be eliminated [29-30]. Solar energy is a clean energy that does not have exhaust. It can protect the environment. It can reduce the greenhouse effect of the Earth's atmosphere [31]. It is a residual energy. Solar energy is important as it is cheap and available in all countries, especially in our country, which receives as direct vertical solar radiation per day (5-6 kW / hr.m^2). The number of hours of sunshine is about 3500 hours per year [32-35].

Till today, many areas of central and southern Iraq suffer from salinity of water and lack of water to drink; solar distillation can obtain fresh drinking water from salt or water and available energy, cheap and non-polluting. The people's need for fresh water and the increase in fuel prices encourage the rapid development of solar energy, especially if we know that the devices that use solar energy low efficiency. It should therefore be simple in design, maintenance, operation and availability of materials. So, the most important objectives of this research is to link the exploitation of solar energy and distillation of water is important to provide drinking water is cheap and available especially in areas that are water-polluted and unsuitable for human use, especially in Iraq, which has a long period of solar brightness and high solar radiation.

II. EXPERIMENTAL WORK

Solar distillation is affected by many variables, some of which can be controlled by the designer or the distillator, and others cannot. The successful design of the solar distillation plant depends on several considerations, foremost of which is knowledge of the thermal properties that govern the distillation of the solar distillate. The knowledge of these properties leads to the correct selection of the properties of the various distillate parts, leading to the best performance of the production of fresh water. In terms of daily and daily efficiency of the distillator, the priorities of the distillate design are:

1- Direction of the distilled solar:

That the position of the solar distillation essential to obtain the maximum possible solar energy, that the process of moving solar distillers towards the sun from sunrise to sunset is difficult, so most of the solar distillers remain fixed to the south so the loss of energy to these distillates up to 50% of energy when moving from sunrise to sunset to face the sun [36]. Where the distillate can be routed to the south to obtain the largest possible solar energy and reduce the shadows arising on the base of the distillate solar, especially in the periods of sunrise and sunset. AC transparent (glass) above the distiller is the second part to be closer to the vertical in front of the direction of solar radiation to reduce the amount of energy reflected. On the glass lid and increase the amount of solar energy entering the distillate to heat the base water, that works for the solar thermal collector may not fit the solar single-effect solar pump used in this research because the position of the glass cover angle of 30 degrees, which represent (0.9 * ø) angular. The EIBling1971 horizon line in the city of Baghdad leaves an area of error during sunrise and sunset periods in the summer in the rear parts of the single-effect catheter, thus reducing the amount of solar radiation falling on the aquarium water [17]. Thus, the angle of the glass cover of angle 20-25° on the horizon is ideal for the simple catheter in Baghdad [37]. This angle of the lid will reduce the size of the vacuum in the distilled basin and increase the density of the steam within the distilled area. However, this angle is disadvantageous. Positioning it at a larger angle leads to the velocity of droplets sliding Intensification on the inner surface of the glass cover and its delay in the gradient to the pool of distilled water inside the basin [38]. This delay, which causes an increase in the layer of water, increases the absorption and reflection of part of the penetrating solar radiation of the glass cover, reducing the amount of solar energy reaching the basin and the water in it. The glass at a higher angle leads to a faster drop of condensate vapor droplets and allows other droplets to condense at a faster pace and increase the amount of condensate vapor on the glass lid and allow space to generate additional steam from the basin and hot water to fill the space. The lower mileage slows the downstream process and leads to slow steam condensation on the lid and slow collection of distilled water, resulting in less space to generate additional steam and slower process due to increased steam pressure in distilled space [39].

1- Tubular base of the plunger:

The surface of the base of the water-resistant metal aquarium must have the potential to absorb the light radiation falling into it and turn it into heat energy that will heat the water and the basin. Metallic iron, aluminum or copper sheets can be used in the manufacture of these absorbent surfaces, but the fuselage is thermal conductivity and cost. That the absorbent surface is dyed with a non-bright black dye to be able to absorb the largest amount of solar radiation falling on it and at the same time reflect the minimum amount of radiation, and the dye does not oxidize and does not change color when exposed to a long period of the sun and resist high temperatures and easy to clean It does not break or break away from the metal surface.

2- Distiller glass cover

The use of glass panels as surfaces for condensation provides many problems than using transparent plastic sheets. Some types of transparent plastics used as condensers in solar distillates absorb part of the solar spectrum, most of which is ultraviolet radiation, which leads to deterioration of the properties of plastics, resulting from the loss of resistance and the tendency to curvature and cracks, that the use of glass panels as surfaces for intensification in solar distillers, especially the thickness of small and good hardness and the appropriate dimensions to reduce curvature, resulting in better results in terms of efficiency and productivity [40]. The normal glass can be used to make it as good as a surface that passes the solar energy falling on it and the thickness of 4 mm, preferably leaving a little distance between it and the surface of the water inside the distiller, then leave 11 cm from the front of the distillery and 34 cm from the rear of the distiller, The volume of air inside the distillate area increases the efficiency and distillation of the distillate. However, we can control this variable by selecting the appropriate depth of the distilled tubing and the appropriate angle of the transparent cover, taking into account the distillation channel of the distilled water under the glass cover, Glass and between the surfaces of the aquarium water. That economic factors control the non-use of more than a glass plate as a cover for solar distillers and theoretically that the use of more than one glass panel leads to a clear reduction in the production of solar distillation [41]. In general, the use of one glass plate as the surface of the condensation and confinement of steam generated within the distilled area and the introduction of the largest amount of solar energy from the thickness of one glass more efficient for simple solar switches and less expensive than the use of two caps in the solar distillers.

3- Heat insulation of distillers:

As the temperature of the metal tubing of the distillator and the water in it and to a certain temperature of the outer perimeter increases, the loss of absorbent energy will increase and if we know that the water inside the distillator will be warm because of the level of the solar collector, the good insulation of the base and the sides of the metal tubing of the solar The good of the distilled mineral bath will maintain the energy absorbed by this basin and the water in it for a long time and continue until the night hours, i.e. the continuation of the night production, especially the isolation by the distilled base, which is the largest energy lost from them, which loses the aspects to absorb the amount of K Pounds of solar radiation. The increase in solar distillate production due to isolation of the base justifies the increase in cost resulting from the use of the insulating material. It was found that the output of the well-isolated solar distillate is about 15% higher than the same area of distillate but without isolation and the same amount of solar radiation [42], and the insulators that can be used glass wool or wood and cork, etc., which must be tolerated for high temperatures and lack of connection to the heat and light weight and do not lose its specifications over time has been selected glass wool to meet these requirements.

4- Distilled Solar Shape

Solar distillers have different forms, each having its own thermal properties and its role in the difference in productivity and efficiency of each. It is possible to say that single-edged and double-tilt distillers are prominent in this field. There are two main factors, namely the efficiency of absorption of solar radiation, the amount of thermal loss, and the cost of construction. In fact, the single-faced distillate facing the south absorbs solar radiation more efficiently than the double-edged distillation. The rear wall of the single-edged diaphragm reflects a large part of the solar radiation falling on it to provide water in the distilled basin. So, it increases the amount of solar radiation supplied to the unit of area from the base of the basin, so increase the absorption efficiency of these types of solar distillers. As for thermal loss, the thermal loss of single-distilled distillers is less than the double-edged diameter of the base unit due to the small surface area of the single-distillate distillation and therefore has a high degree of thermal efficiency compared with the other forms of solar distillates that are productive [43]. The initial cost of a single-inclination catheter is much lower than if a double-dip distiller was manufactured where the cost of the first type is equivalent to half the second manufacturing cost of the quantity of distilled water produced [44]. For these reasons, the simple distillation was selected Yale singular in this research.

5- Solar distillation blockage efficiency

That the steam leak generated from inside the solar distiller is one of the most important factors in reducing the productivity and efficiency of solar distillates clearly, so the use of suitable materials to close the solar distillers tightly closed and prevent the leakage of steam generated within the distilled area to the outside, which will increase the amount of distilled water produced, It can withstand long periods of operation, moisture resistance, high temperature and non-stiffness.

6- Water depth in the distilled basin:

Reducing the water depth in the solar distilled tubing means reducing the mass of water that receives thermal energy from solar radiation, which in turn, leads to high distillation at the base water temperatures [45]. Thus increasing evaporation and increasing productivity. In the basin leads to a clear fluctuation in the amount of distilled water produced due to the change in the amount of solar energy absorbed due to different weather conditions for one day. This effect is less pronounced in distillates where the water depth of the base is large because of the thermal storage of water where the distillation process is slow, continuous and late at sunrise and increases after the absence of the sun due to the large decrease in the surface temperature of the condensation (exposed to the outside atmosphere) The distillation process continues in distillates with large amounts of water during the night and thus reduces the fluctuations in productivity of the distillate with a small depth. In addition, 2-6% of the solar energy falling on the saltwater basin reflects the surface of the water, 30% absorbs water from the aquarium and the rest is applied to the pelvic metal. Therefore, productivity can be increased with increasing water absorption of solar radiation by adding pigments to the water to be distilled.

7- Cleaning distillers

For the purpose of absorbing the largest possible amount of solar energy falling and to prevent the accumulation of blocks of reflective layers of radiation from the salts and mud with continued distillation work and the continued deposition of these materials in the solar distillation should be disposed of. Sometimes layers of these materials are formed over the surface of the aquarium to prevent the sun from reaching the water and the distilled base. Therefore, the distilled bottom valve should be placed when it is manufactured for the purpose of drawing and changing the water in the basin between time and time and washing the distilled basin. Or by working the base of the distilled tub can be dragged, cleaned and returned again, or use the continuous feeding method to maintain a constant depth of water in the distillate to reduce the amount of salts precipitated and this is what was used in this research.

The design and fabrication of the used distillers in this study:

A - Simple solar distillate:

In addition to the welding and fixing of a small channel to collect the distilled water from the transparent cover, this longitudinal channel is extended on this side of the distillate and the 5° inclination angle (a degree of distilled tip to the other end). The distilled rear is 36 cm high and the top of the distillate is 30 degrees above the horizon. The upper edges are bent horizontally with 1 cm width on each side so that the glass (transparent cover) is installed on them, but before placing the transparent glass cover and to ensure that the steam is completely sealed inside the distiller and prevent its leakage, then paste a rubber pad used in the tires and width of 1 cm also and your thickness 3 mm, where this paste was pasted by silicon material to ensure that the rubber fill was firmly affixed to the top edge and then the glass was affixed to the fill. The inner surface of the water tank is painted with a non-bright black dye to increase the absorption of solar radiation and not reflect it to the distilled outside.

As for the hot saline flow into the solar distilled basin, the flat solar collector reservoir was delivered directly by a rubber tube 1.24 cm and controlled by a raft within the solar distilled tubing to make the water flow into the distillate to reduce the salts and dirt in the tub and maintain the level Water in the basin at a height of 1 cm to ensure the continuation of the process of distillation and non-cut. The distilled water from the transparent cover is collected in the inlet assembly channel inside the distiller and exits from a hole on one side of the distiller. A 2-1 / 2-inch rubber tube is inserted into the collecting bowl to ensure that the steam generated inside the distillator is not trapped in the exit Distilled water. A wooden box with a base area of 110 cm, width 50 cm, height 11 cm from the front and 39 cm from the back of the box was constructed. The metal basin was placed inside it with a distance of 5 cm from each side and from the base to the thermal insulation (Glass wool) between them. The wooden box was constructed of 2 cm thick wood planks to be part of an additional insulator for the basin. Figures 1 represents a photo of the used distillers in this study.

Proposed design of the solar distiller working by drips

The solar collector inclination is one of the most important factors affecting the performance of solar distillers, so the conventional design of the solar pump is the absorption plate horizontally. This cannot be exploited by the solar radiation falling on it, as well as by the rise of the side edges that prevent part of the solar radiation by heating the absorption plate. The proposed solar distillation, shown in Figure (1), is designed to make the solar distillation continuous during the day due to the high heating of the absorption plate resulting from its tilt at the angle (the ideal angle of the solar complexes of Baghdad City). The same assembly was used in the previous sections for insulation, metal type and other details. The assemblage was fitted with a diameter that was fixed along the absorption plate and was packed with a hole (38) cm diameter. The water was continuously dipped on the absorption plate and condensed after touching the hot adsorption plate, the non-condensing water is rotated by a small pump at the distilled base. The pipe used was 1 m long, the length of the distilled used and diameter 0.635 cm has been closed from one end and the other side with the water supplied to the pump and coming from the distillation basin, the hole of this pipe with fifteen holes and 10 cm between hole and another and diameter of each hole 1 mm and then fix. This tube is higher than distilled to allow the salt water to flow on the surface of the slant absorption plate and then to control the cooling water so that it does not vibrate with a water lock in the tube.

Temperature measurement and distilled water and wind speed: To calibrate the used thermocouples, the temperature of the melting of ice and the temperature of boiling water by thermocouples were measured by leaving the boiling water cooled and recorded temperature every five minutes by double. The thermocouples are then connected to an electronic thermometer to measure temperature and accurately 0.1°C. Four of these thermocouples were glued to the surface of the glass condenser, two on the outside and two on the inner surface to give a clear distribution of the temperature to the entire surface of the transparent cover after taking its rate to represent the temperature of the transparent cover. A second double tube was placed in the bottom of the distilled tubing to measure its temperature and the last one was placed in the basin. The upper part of it was pressed into the transparent lid to measure the temperature of the steam inside the distiller and to ensure its survival, Prevents double movement and keeps it immersed in vacuum distilled tub. As for the temperature of the water coming from the reservoir of the solar collector to the distiller, a hole was made in the pipe connecting them as much as the diameter of the mercury thermometer allowing for the development of a mercurial thermometer, and the temperature of the external environment was measured by a mercury thermometer placed in the shade. The amount of distilled water collected is measured by a 1 liter cylindrical glass container measuring the distilled water collected each hour and at the beginning of the following day.

Fig. 1: Photo of the studied distillers

Test procedure

A number of practical experiments were carried out on the solar distillates under different climatic conditions of the city of Baghdad (latitude 44.36 east and 33.34 north latitude). Experiments were carried out concurrently for both distillates (A) and (B). Each experiment was repeated four times per month of the test months to ensure the reliability of the results. Experiments in which the diameters of the holes in the tubing were changed were also carried out sequentially to ensure as much as possible similar working conditions for comparison with each of the diameters used in the experiment. All experiments (after making sure of the cleanliness of the glass covers) will start from 8:00 am at the rate of eight or ten hours per test and according to the season for the period between February and July 2018.

During all experiments, the following variables were recorded for each hour: productivity (quantity of distilled water), average water temperature in the distillation basin, compensatory water temperature entering the distilled basin, temperature of the glass cover, ambient temperature and amount of solar radiation. Wind speed is impressive on both distillates with the same amount so it is not measured and there is no drained water from the distilled tub.

III. RESULTS AND DISCUSSION

A number of practical experiments were carried out on the solar distillates under different climatic conditions of the city of Baghdad (latitude 44.36 east and 33.34 north latitude). Experiments were carried out concurrently for both distillates (A) and (B). Each experiment was repeated four times per month of the test months to ensure the reliability of the results. Experiments in which the diameters of the holes in the tubing were changed were also carried out sequentially to ensure as much as possible similar working conditions for comparison with each of the diameters used in the experiment. All experiments (after making sure of the cleanliness of the glass covers) will start from 8:00 am at the rate of eight or ten hours per test and according to the season for the period between February and July 2018.

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The solar radiation intensity fall has significant impact on the performance of solar distillers, which was observed when the intensity of the radiation received at the base of the distillery increases productivity and efficiency and with the decrease of falling solar radiation decreased productivity and efficiency. The intensity of the total solar energy falling with daylight hours to reach the maximum value, this change as is known, is the product of the earth's radiant motion around itself and the angle of the fall of the solar radiation on the surfaces. The temperature of the water outside the solar heater, as well as the water inside the distillate, with the passage of time and the maximum value is a period late than those that reach the intensity of solar energy a day, and then take a little lower due to heat insulation of the complex and the attached tank and the pump is due to the fact that the solar energy falling at the beginning of the sunrise is used to heat the solar complex and raise the temperature. The water is in it and the same talk for water inside the distilled basin in the morning, where the loss of heat a few of the cold water in them and over time and with the increase of solar radiation falling water temperature rises and turn the difference in temperature between him and the outside air and lettuce Thermal losses increases with a decrease in the incident radiation with the sunset.

The diameter of the hole for the water pipe was first installed in the distilled basin at (1 mm) and the experiments were conducted simultaneously and under the same climatic conditions for both distillates (A) and (B). Through all experiments, the current design provides more room for solar radiation fall through reflective plates that reverse the radiation falling on the distilled base and lead to more water heating in the distillation basin as well as increase the surface area of the condensation, which has a clear effect in increasing the quantity Water produced compared with conventional solar distillers because of the current balance between increasing evaporative water and sufficient surface area to condense water. Figure (2) represents the daily productivity of distilled water for both distillates under 31.9 MJ / day during the test hours (8 AM to 5 PM). An increase in the productivity was achieved by the modified distillate (A) compared to the conventional distillate (B) in all the experiments conducted without the production of the ellipse.

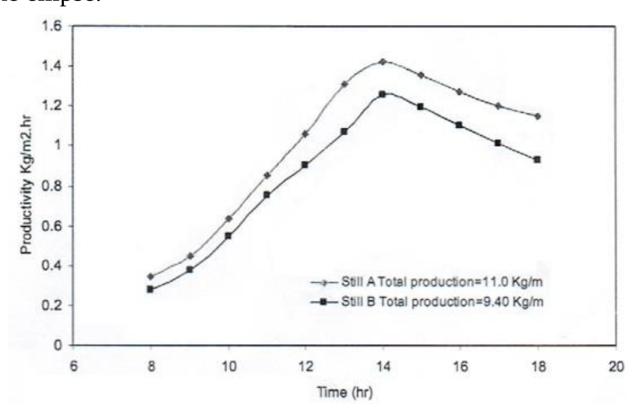

Fig. 2: Daily change in productivity with daylight hours for both distillates for diameter (1 mm)

Figure (3) shows the daily productivity rate during the day with the intensity of solar radiation for different months of the year and comparing the results with the distiller (B) under the same climatic conditions and through which we notice the obvious increase in productivity and for the reasons mentioned above.

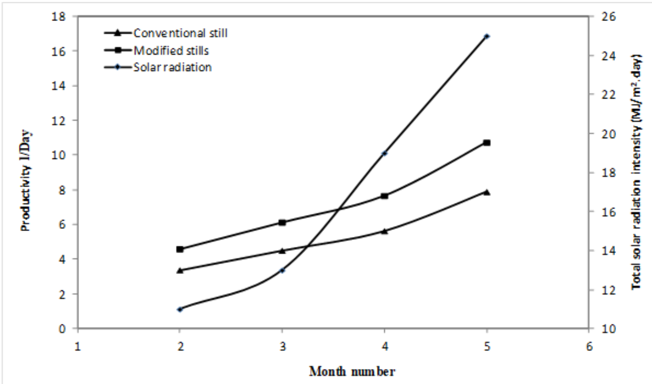

Fig. 3: Daily productivity changes with the solar radiation intensity variation for different months of the year

Figure (4) represents the comparison of the two distillates in terms of efficiency during the probation period. Figure (5) shows the change in daily efficiency with the intensity of solar radiation during the different months of the year, where it was found that the efficiency of distillate (A) All the tests carried out because of the increase in the amount of water produced for the same amount of solar radiation to the two distillers, as the additional heating resulting from the reflected radiation from the base distillate contributed significantly to improve performance, and this is also illustrated in Figure (6) Reflective plates to distilled base on productivity that there is an increase in the amount of production (approximately 14%) in the case of adding reflective plates to distilled basin base.

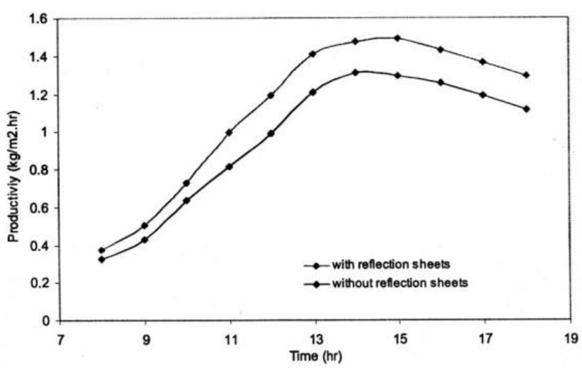

Fig. 4: Change the efficiency for daylight hours for both distillers to (1 mm) depth

Distillation testing with different water depths and depth effect on the efficiency and distillation efficiency

In order to verify the effectiveness of the current design (A), four different depths of water within the distillation basin (5mm, 10mm, 2mm, and 3mm) were tested for four consecutive days. Two readings are recorded for each depth, the first for the distiller A (Fig. 7) and the second for the distiller B (Fig. 8). The results showed that there is a preference in the productivity of distillate (A) in all the depths of the water used in the research and in the range of (18% -24%). The results also showed that the depth of water inside the distillation basin has a significant effect on productivity; the water inside the distillation basin will increase with evaporative rate.

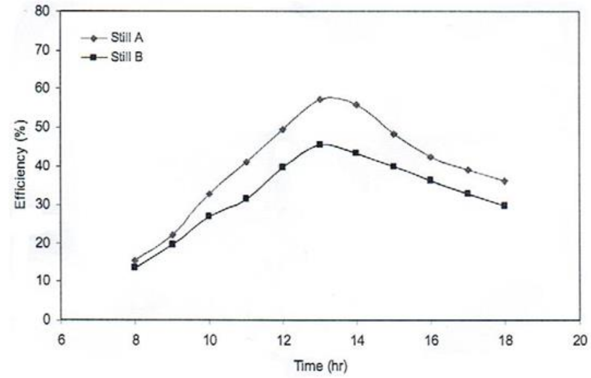

Fig. 5: Daily efficiency change with solar radiation for both distillates for different months of the year

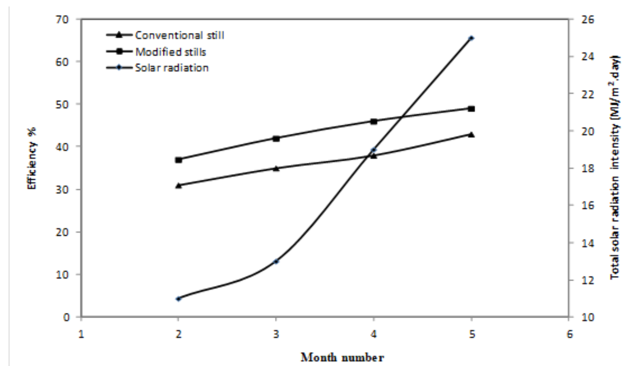

Fig. 6: Effect of addition of reflective sheets to solar radiation on hourly productivity

The results obtained during daylight hours (without night output) for both distillers showed that the use of the lowest depth of water (5 mm) showed an increase in productivity of 10% compared to the depth of 10 (10) mm) and gave an increase rate of (17%) compared to the depth (2 mm) and also gave an increase of (19%) compared to the depth (3 cm). This increase is due to increased rates of heat transfer the less water thickness inside the distillation basin and thus increase the rate of evaporation and on the other provides sufficient space for the condensation given by the current design of the pump. Figures 9 and 10 illustrate the change in efficiency of both distillates to different depths of water within the distillation basin. The daily efficiency is calculated from the following relationship: $\eta_h = (P.L_h)/I_T$ and note how to increase efficiency with decreasing water depth inside the distillation basin. The distillate efficiency (A) is (15% -57%) while the distillate (B) efficiency is (14% - 51%) to the same depth (0.5 cm).

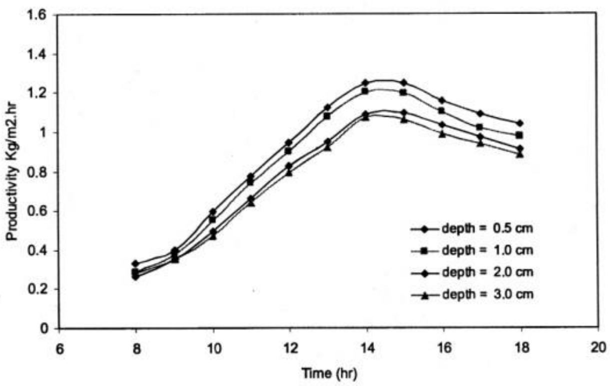

Fig. 7: Productivity variation with daylight hours for different depths of water for the distiller (A)

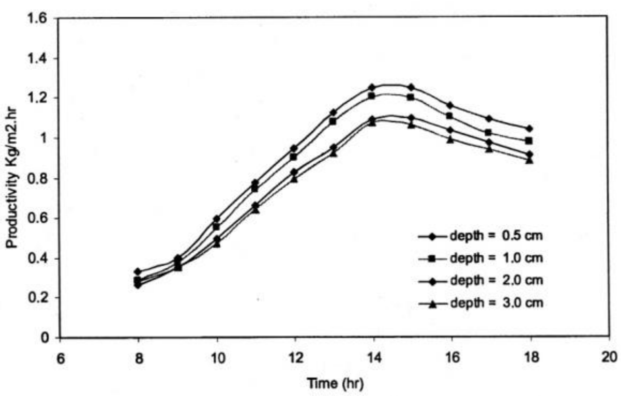

Fig. 8: Productivity variation with daylight hours for different depths of water of the distillator (B)

Effect of current design on temperature difference (Tw-Tg)

The results indicated in the previous paragraphs showed an increase in productivity achieved by the modified design (distilled A), which facilitates the addition of reflective plates to help increase the temperature of water in the distillation basin. Figure (11) represents the temperature difference between the water in the distillation basin and the glass cover (Tw-Tg), where (10 ºC) difference in degrees was obtained for the diameter (A) and (4 ºC) for the diameter (B). The increased temperature difference between the water in the distillation basin and the glass cover (Tw-Tg) is due to the significant effect of the reflective surfaces added to the distillate base, which contributed to the additional heating of the distillation basin. In all experiments, temperature measurements were similar in terms of thermal behavior but different in values by type of experiments and operational conditions. Figure 12 represents the results of temperature measurements (water temperature, glass cover temperature, external air temperature) for sample other selected tests.

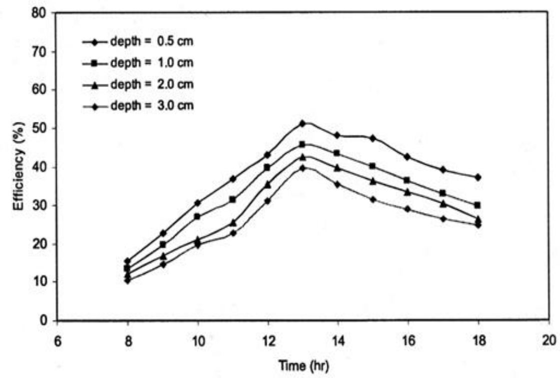

Fig. 9: Change efficiency with daylight hours for different depths of water for the pump (A)

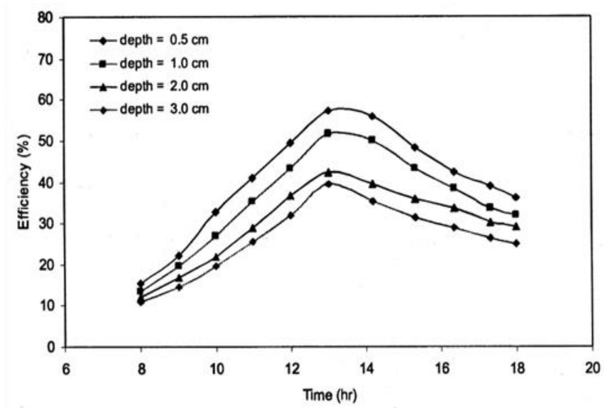

Fig. 10: Change efficiency with daylight hours for different depths of water for the pump (B)

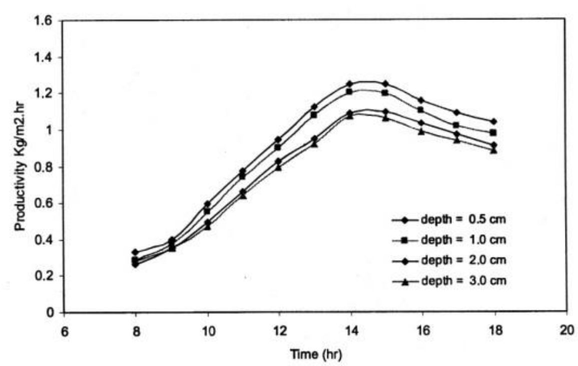

Fig. 11: The efficiency difference with daylight hours for distiller (A) at variable depths

CONCLUSIONS

In this study, a new design was proposed for a simple solar distiller that works in a drip method and its productivity and efficiency were compared with a single-slope solar distiller manufactured for this purpose. The results of the study showed that the suggested distiller has a higher yield than the simple single-slope distiller. This productivity is also increased by putting reflectors on the distillers to focus the sun rays. In this case, the proposed distiller yield was increased by 14% compared to the single-slope solar distiller.

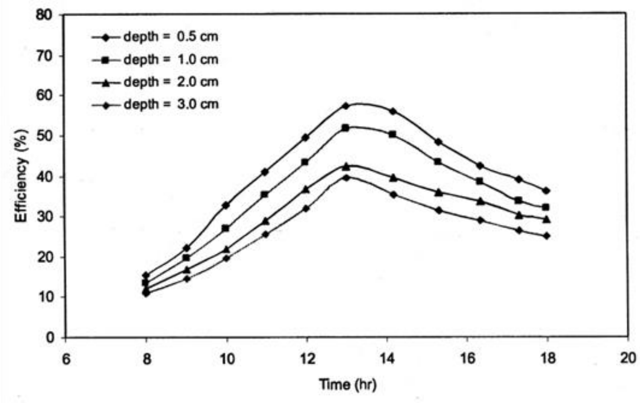

Fig. 12: The efficiency difference with daylight hours for distiller (A) at variable depths

When examining the appropriate depth of water in the distilled basin, the lower the depth the greater the distillation. The preferred depth is 0.5 cm, which yields a higher yield of 10% compared to 1 cm depth. The proposed distiller efficiency ranged from 15% to 57% while the simple single slope solar distiller efficiency ranged between 14% to 51% at the same depth (0.5 cm).

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