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"A STUDY ON VARIOUS TYPE SOLAR STILL"

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ABSTRACT

At present pure and usable water decreasing day by day because of increasing population. A large percentage of human health is affected due to impure and saline water. Indeed, even today, immature nations and creating nations confront a gigantic water shortage in view of instrument and contamination made by manmade exercises. Without influencing the biological content we need to clean the water. Solar still is basic concept of purifying the water from impure water, in our planet solar energy is a best form of renewable energy, that utilization of sun based warm vitality, which is openly and inexhaustibly accessible. In 21stcentury we are using advance and advanced technology in every field but some territories are still remote and undeveloped where even the essential necessity of electric force is either rare or absolutely missing till date. To make clean water and provide usable water we have best alternative source of energy is a solar energy. Normally sunlight based still having low efficiency and effectiveness so that we are going to increase the con-dancing water capacity and increase the solar still efficiency in the further research.

Key Words: *Solar still, single slope, solar still productivity, efficiency, effectiveness.*

I. INTRODUCTION

A solar still is a simple and passive device used to desalinate or purify water using solar energy. It's particularly useful in areas where clean drinking water is scarce, and traditional water treatment methods are not readily available. Solar stills work on the principle of evaporation and condensation to separate pure water from contaminants, including salt, minerals, and other impurities.

Here's how a basic solar still works:

Collection Surface: The solar still consists of a shallow, sloped, and transparent (usually glass or plastic) top surface, which is exposed to sunlight. This surface allows sunlight to enter and heat the interior of the still.

Water Source: Contaminated or salty water is poured or collected in a basin or trough located at the bottom of the still.

Evaporation: As the sunlight penetrates the transparent cover and heats the water in the basin, the water starts to evaporate, turning into water vapor. The heat from the sun is the energy source for this evaporation process.

Condensation: The water vapor rises and condenses on the cooler surface of the transparent cover. This condensed vapor forms droplets and trickles down the inclined surface of the cover.

Collection Channel: A collection channel or groove along the edge of the cover directs the condensed water droplets to a collection point, typically a container or collection vessel.

Pure Water Collection: The condensed water droplets, now purified through the process of evaporation and condensation, are collected in a separate container, leaving behind impurities, such as salts and minerals, in the original water source.

Solar stills are relatively simple and low-tech devices that can be built using readily available materials, making them suitable for use in remote or resource-limited areas. While they are effective at producing clean drinking water, their output is typically low compared to more advanced water treatment methods. The efficiency of a solar still depends on factors like sunlight intensity, ambient temperature, and the design of the still itself. Nonetheless, solar stills can provide a reliable source of purified water in situations where other options are limited.

II. LITERATURE REVIEW

Single Basin Solar Still Concave Wick Solar Still: Kabeel (2009)

Kabeel (2009) investigated experimentally on the performance of a concave wick type solar still where the basin is made in the shape of concave structure with cover on four sides, which can be seen in Fig. 4. Steel frame support the pyramidal glass surface and a black cloth in kept inside the surface for better evaporation of saline water. Experimental studies concluded that the water temperature is less than the wick temperature, which the wicks absorbing emissive power creating a driving force on evaporation of water. Solar still efficiency improved by 50% than conventional single slope solar still, where the condensing and evaporation area of present model is more than basin area. Typically the total yield from the solar still was found as 4.1 kg m–2. More over the spacious area and insulation thickness is reduced by 50% in case of concave basin of solar still.

Hemispherical solar still:

Figure 5 shows the schematic diagram of a hemispherical dome cover solar still. Driving force is the important phenomenon on fresh water yield as it is a parameter of temperature difference between water and glass. The yield of solar still not only depends on glass water temperature difference, also it depends on wind velocity, ambient temperature and cover temperature. Arun Kumar et al. (2012) investigated a hemispherical cover solar still with and without cooling medium. From their study the effect of cooling the surface of cover improved the efficiency from 34-42% with a fixed flow rate of water as cooling medium at 10 ML min–1 on the entire surface. Also, the effect shows that the yield improved by 1.25 times than without cooling. The average output with and without cooling is found as 4.2 and 3.5 L m–2 day–1, respectively. The improvement in yield is due to dome shaped cover instead of flat plate cover. Also, the area of aperture area is more for incident radiation, whereas from conventional still shadow effect is more.

Inverted absorber solar still: Figure 6 shows a single basin inverted absorber solar still. In either way heat input to the solar still can be given which was proposed by G.N. Tiwari. Tiwari and Suneja (1998) and Dev et al. (2011) experimentally investigated the effect of reflecting the solar radiation through the bottom of the absorber. The yield of inverted absorber increases by two times than conventional solar still yield. Other parameters such as multiple basins, water depth and effect of wind velocity are also discussed. While analyzing different water mass the evaporative heat transfer is higher at minimum water mass. Due to the higher water depth inside the basin, water could not able to heat up to a higher temperature. The yield of solar still drops from 5.2-3.5 kg m–2day–1 for 0.01-0.1 m, respectively. Dev and Tiwari (2011) theoretically and experimentally derived the characteristics of an inverted absorber and single slope conventional solar still. The results showed that the instantaneous gain and loss in efficiency and distillate are similar to the previous model while the depth of water maintained at 0.01 m. Tiwari and Suneja (1998) investigated the performance of solar still and arrived to a conclusion that there is an increase in temperature of water in the absorber due to the reduction of heat loss from absorber and increased value of absorptivity. The depth of water is an important parameter for the water temperature and it is increased by decreasing the water depth in the basin which simultaneously increases the evaporative heat transfer. As the water depth increase from 0.08-0.1 m there was no significant improvement in the convective and radiative heat transfer coefficient.

Pyramid single basin solar still: Taamneh (2012) experimentally studied a pyramid solar still under forced and natural convection. Experiments are carried out in Tafila city (Jordan) and performance of solar still with and without fan show that the reduced temperature of glass increases the condensation with larger temperature difference. The solar still yield during mid-noon on experimental day with and without fan found to be 0.4 and 0.35 kg m–2h–1, respectively and the maximum efficiency of the solar still was increased from 40-50% with fan as cooling. Hence, with the help of a solar PV assisted fan cools the surface areas of the glass for better condensation of vapor.

Nagarajan et al. (2014b) conducted a detailed review about the solar collectors using nano fluids in solar thermal applications. Nagarajan et.al.(2014a) and Sathyamurthy et al. (2014a) investigated the performance of a triangular pyramid solar still as shown in Fig. 7. The results showed that the yield from solar still is higher and for a least water mass of dw = 2 cm it was found as 4.2 kg m–2 day–1.The convective and evaporative heat transfer from the solar still is equal to the Duckle’s prediction and the solar radiation follows the similar curve of water temperature. This proves that the water temperature is directly proportional to solar radiation. The water temperature throughout the basin is equally maintained and this is due to the reduction of shadow of side walls falling in the solar still. On the economic and space constraints the new model is more efficient for 75 and 50%, respectively than a conventional solar still.

Spherical solar still: A schematic diagram of a spherical solar still is shown in Fig. 9. Saline water from the storage tank is fed into the absorber which is placed inside the spherical shaped cover through which the solar radiation is transmitted to evaporate the saline water. The major advantage of the solar still is from all the direction the radiation is transmitted and the thermal equilibrium of water is maintained for evaporation. Dhiman (1988) analysed a spherical solar still on the thermal performance and results have showed that the efficiency of solar still is increased by 30% than the conventional solar still.

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Tubular solar still: A simple mechanism of a tubular solar still is shown in the Fig. 11, where it usually consisting of transparent cylindrical tube in which a rectangular absorber is placed. The solar intensity is transmitted through the cover reaching the absorber and heat up the water. The water evaporated in the inner surface forming a thin film and rejects its latent heat for condensing. Due to gravity, the condensed water slides through the inner surface of cover and get accumulated in the calibrated flask.

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Inverted absorber double and triple basin solar still: The effect of number of basin and water depth in multi basin inverted absorber still (Fig. 14) was theoretically and experimentally determined by Suneja and Tiwari (1999a). The results agree that, theincrease in water depth on the lower basin increase the daily yield of fresh water. Figure 15 shows the simple inverted absorber triple basin solar still. The daily yield of inverted absorber triple basin solar still is higher while comparing it with conventional still and increase in depth of water in the basin yield is lower. At a water depth of 0.02 m the yield was 11.5 kg m– 2 and keeps on decreasing when the depth of water increased. A comparative analysis has been carried out to analyse the performance of single and double effect. Results shows that an average yield of 4.15 and 6 kg m–1 day–1 for single effect and double effect solar still respectively.

III. CONCLUSION

Many solar stills have been studied in detail in this review covering all the aspects of design specifications. Also the effect of design and operating parameters on the distillate productivity of various stills has been presented. Write about design of solar still following conclusions may be drawn. Maximum yield was achieved using the least water depth. Lower thickness glass cover is preferred compared with higher thickness glass cover. Feed water temperature and quality can also affect output. The greatest enhancement to solar still performance is obtained using multi-effect and active concepts. Two main bottlenecks to the output are the solar energy collection for evaporation and the dissipation of heat for condensation. Many types of solar energy collector can be used to enhance performance, including flat plate collectors, evacuated tubes ,and solar ponds Particularly promising among these is solar still with solar pond which enhances the productivity by about 80% over the conventional stills. Typically such active concepts require pumps and/or fans, which may use electricity, adding to expense and complexity.

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