PULSATING HEAT PIPE PYRAMIDAL SOLAR STILL

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Abstract -. Water is the most essential need for everyone sometimes not available to all. Many remote and hilly area suffer water scarcity in daily life. Solar desalination is one of the techniques for achieving this common goal of freshwater yield. This study delves into the integration of pyramidal solar stills coupled with pulsating heat pipes (PHP) to maximize heat transfer and enhance overall system performance in solar desalination. System components and factors affecting productivity, including water depth, insulation, cover inclination and innovative designs, are thoroughly investigated. The experiment focused on comparing the performance of two types of solar stills. The conventional pyramid solar still (CPSS) and the modified pyramid solar still (MPSS) integrated with a pulsating heat pipe (PHP). The study evaluated their efficiency in freshwater production, energy utilization and economic feasibility. The MPSS's superior performance in freshwater yield, hourly productivity and thermal efficiency across varied water depths

***Key Words*:** Pyramidal solar still, Pulsating Heat pipes (PHPs), Solar Desalination Solution

1. INTRODUCTION

Life, sanitation, and sustainable development all heavily depend on freshwater resources. Circulating water, which are the source of freshwater on Earth, are gradually decreasing in amount.96.54% of the earth's waters are salt water and from 2.53% of freshwater, only 0.36% are accessible. In areas where the population growth rate is high, water demand has exceeded exploitation and thus, the insufficiency of freshwater is considered a major threat for human populations. Desalination seawater with desalination systems, due to the unlimited saltwater resources, can be considered an appropriate solution for meeting the ever-increasing demand of freshwater. Various methods have been proposed and implemented for this purpose. Seawater desalination methods are classified into two main categories:

1.Thermal process (phase change).

2.Separation based on the membrane (or single-phase process).

2. LITERATURE REVIEW

These research findings highlight the significance of solar desalination as a sustainable solution to address water scarcity. By harnessing solar desalination systems can efficiently purify water, offering a promising approach to ensure access to clean water in regions facing water shortages. Factors such as latitude, cover inclination, and thickness play crucial roles in optimizing the performance and efficiency of solar stills, with innovative designs and configuration enhancing their effectiveness in producing fresh water. Adhering to recommendation such as a 45 degrees inclination angle for single slope solar stills can further improve their productivity and overall performance, contributing to a brighter, water-abundant future for communities worldwide

3. METHODOLOGY

The solar stills are commonly used for the water treatments and water purifications and one can understand the key concept of solar stills easily the need for the sanitation and sustainable water supply are the

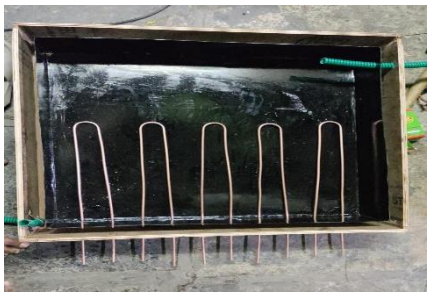

Figure 1basin area

important aspects that theses solar stills are made ,these are many types of solar stills came into the existence with the change in surface of the condensation area that

the glass mounted on the top the solar stills and these are commonly the plane types ,like the plate and after that the shapes of the mountings are altered to the hemispherical ,triangular and many more ,which we can observe that the increased the surface area of the glass so the efficiency of the heat usage by the radiation improved.
The main parts of the solar stills are:

1.the water basin
2.the glass or the transparent cover on the top
3.the condensation surface
4.the collection channel

With the use of some insulation and casing we can entrap the heat energy from the radiation for a little more longer. The evaporation of the water placed in the basin, and also the condensation of the water that has been done afterwards ,the water that has been condensed will be flown downwards towards the channel, so that the water will be pointed towards the outlet line for the water collection area at the outside of the still placed

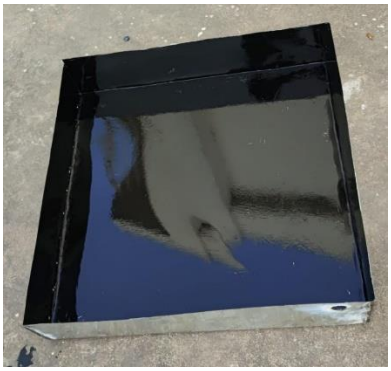

Figure 2 water basin inside the solar still

4. PROPOSED SYSTEM

The Proposed system refers to the plan for the modification of the solar stills cost efficiently and with some systematic alterations in the design we can improve the efficiency of the solar still with a huge difference. The effectiveness and the environmental suitability area also the factors that has to be considered. With the help of the pulsating heat pipe that has been mounted to the conventional system we can improve the effectiveness

And also with the help of acrylic sheet of the required thickness we can replace the silicate glass that we can easily reduce the cost of the overall system with a small change in the thermal efficiency of the entire solar still that is because of the difference of the thermal conductivity of glass and the acrylic material are three times a part. The Pyramidal solar stills are very helpful with the design because of the effective surface area for the water condensation, the greater the surface area the better the haet exchange including the other parameters into the considerations which will might change

4.1 EFFICIENCY FACTORS

The process parameters that has to be considered while using a solar still in a particular area are

CLIMATIC FACTORS

1.The Radiational Intensity

2.The Surface Area

3.The Ambient Temperature

4. The weather conditions

DESIGN FACTORS

1. Inclination

2. Insulation

3. Depth of water

4. Basin material

5. FABRICATION PROCESS

Purchase the required materials from the nearby stores, we can easily find the materials for the solar stills within our areas because of the availability of the common materials will be used in this fabrication process the process starts with the making of the casing for the solar still system, make a wooden box of required dimensions with the help of plywood material and then create a steel box opened on top same as the wooden casing that has been made with the required dimension cut the acrylic sheets to the required dimensions so that

we can stick them together on the sour sides off the box that we have made so that we can make a pyramid shape and then by creating the PHP setup and mounting the two box sets together with the help of copper pipelines

we can finally create the PHP Solar still of pyramidal shape

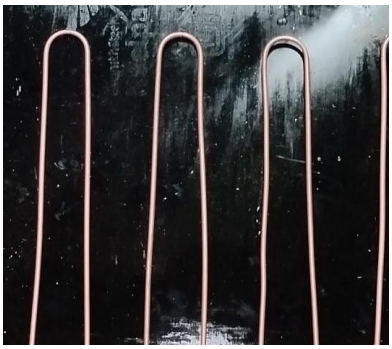

Figure 4 copper pipe bent for PHP line

Figure 3 Pyramidal still coupled PHP

5.1 MATERIALS USED

1. Plywood Board
2. Iron Sheet of 4mm thick
3. Copper pipe of 50 feet 3mm diameter
4. PVC pipe of 180 cm
5. PU foam of 200 ml
6. Pipe valves and Clamps
7. Acrylic sheet of 4mm thick

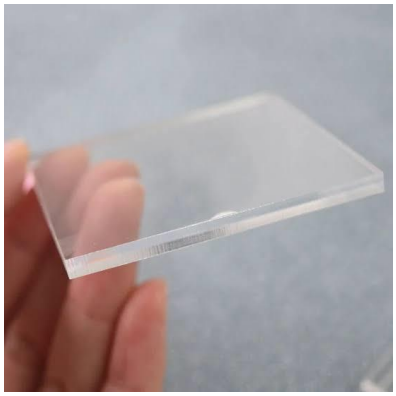

Figure 4 Replacement of glass with 6mm Acrylic Sheet

5.2 RESULT

By the experimental analysis and thermodynamic analysis by hourly and daily productivity of the stills we have concluded that the pyramidal solar still with PHP works effectively with the minimum change and modification of the conventional solar stills and have made a test result with the bar graphs for the CPSS (Conventional Pyramidal Solar Still) and our PHP type MPSS (Modified Pyramidal Solar Still)

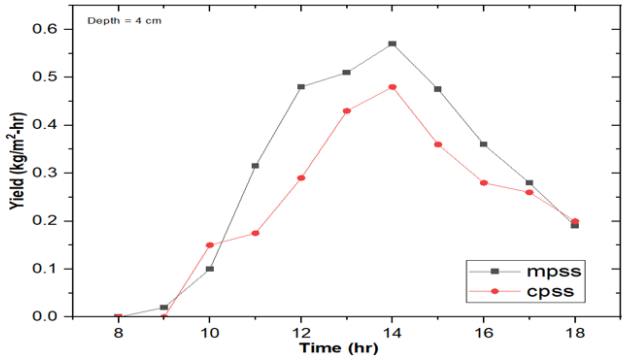

Figure 6 MPSS and CPSS hourly productivity for 4cm depth of water in basin

6. CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

By Using the Eco Friendly method of water desalination for the optimal utilization of the water and the radiational energy from the sun helps to reduce the usage of the chemical methods of purification of the water in the most of the areas and for the remote sites the PHP type Pyramidal solar stills are very effective with the use of some PCMs (Phase Changing Materials) we can further improve these model to another step forward

6.2 FUTURE SCOPE

With the help of this type of extended versions of solar stills we can improve the productivity of the water desalination and purification of water with greater efficiency, even the availability of the raw materials for this PHP coupled solar still are easy to access and thus we can use them with flexibility even in the remote areas which can be more helpful for many of the people in that particular areas. Due to the rapid growth in global warming and the environmental pollution the scarcity of water is also increases rapidly ,we can identify with the record of the water contamination charts from the areas for a particular area by testing the water samples for a certain tests

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