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DESIGN AND FABRICTION OF SOLAR WATER DISTILLER

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ABSTRACT: The objective of this project is to develop a solar water distiller which can clean water from almost any source, portable, reasonably priced. A reliable estimate was produced based on the outcomes of the project calculations to Prototype the distiller and troughconcentration system's most efficient geometry, one that will improve condensation/evaporation and recycle waste heat to cut down on thermal losses. This was accomplished using a setup that included a parabolic solar trough and a specifically designeddistillation unit. In order to heat the arriving unclean water before it is sprayed into our conventional system, the sun's incoming solar radiation is channelled and concentrated into areceiver pipe using a parabolic trough. built distillation equipment, where it evaporates and then condenses back into pure drinking water.

Keyword: renewable energy, pure water, Solar Distillation, Solidworks software, fabrication.

1. INTRODUCTION:

Basically no safe drinking water left on the planet purification. Only 1% of the water onEarth is fresh and liquid, and almost all of it is contaminated with pathogens and hazardous substances. Purification of water supply is crucial because of this.

Additionally, natural or man-made disasters can quickly undermine or ruin Along with food and breathing, water is a basic need for humans. There is standard filtration systems.This creates a very difficult scenario for people attempting to prepare for such situations and maintain keeping their loved ones and themselves protected from the numerous illnesses and hazardous substancesfound in unclean water. To obtain pure water,everyone wants to figure out how to use the available energy sources to solve the aforementioned issue. Fortunately, these issues can be resolved. This technique not only has the ability to eliminate a huge rangeof pollutants in a single step, yet is easy economical, and environmentally safe. That is solar usage.

2. LITERATURE REVIEW:

Malik et. al. [1] established a link between the rate of heat transfer between glass and water (hewg) and the rate of Lewis's link ledto the development of the convective heat transfer coefficient from water to glass (hcwg).

Sampathkumar et. al. [2] carried performeda thorough analysis of different active solarstill designs and identified various variablesinfluencing how well these solar panels operate. They performed thermal modellingfor various active single slope solar distillation system types and highlighted thepotential for other study areas.

Mario and Giovanni et. al. [3] created astraightforward solar still using tubes (Fig. 8) to desalinate seawater. It evaporates portion is made up of horizontal, thinwalledplastic or glass tubes having an inner diameter of 0.10 to 0.25 m that are half filledwith sea water, which absorbs sun radiation.

E. Delyannis et.al.[4] conducted a historicalanalysis of desalination methods and the useof renewable energy with an a focus on the use of solar energy for desalination andcame to the conclusion that what is a new development for us will be history for the next generation.

Kabeel et. al. [5] The most economical solarstill was chosen after conducting a cost analysis of 17 popular solar still designs. The best average and maximum daily productivity are found in one slope and pyramid-shaped solar stills. The maximum average yearly production of solar stills is 1533 L/m2, while the lowest average annual productivity is 250 L/m2 for modified stillsequipped with sun tracking equipment. Thewaste water will be distilled.

Velmurugan et al. [6] created a system and added fins, sawdust, black rubber,sand, pebbles, and sponges to the basin. When compared to the standard singleslope, they discovered that the evaporation rate rose by 53% with the additional surfaces.

Kumar and Tiwari et. al. [7] the deepbasin hybrid (PV/T) active solar still'scalculated internal heat transfer coefficients. They used thermal models created by several researchers to analyse the interior heat transfer coefficientsbased on outside experimentalobservations of hybrid (PV/T) solar stills for the composite climate of New Delhi. They came to the conclusion that, when comparing the findings with experimentalobservations, the Kumar and Tiwari model (KTM), as opposed to the other models, gave a better validation of the results. Convective heat transfercoefficients were found to be 0.78 and 2.41 W/ m2-K on average annually at 0.05 m of water depth for passive and hybrid (PV/T) active solar stills, respectively.

Ganeshan and Nirmala khandan et. al. [8]exploited the laws of natural gravity and the principle of vacuum to create a solar stillthat maintained a vacuum in the evaporation chamber. created a model using the head of the barometric pressure. They obtained a yield of 7.5L/m2 -day of evaporation area using only direct solar radiation, demonstrating the correlation between thetheoretical model's predictions and the measured performance data. The system produced 12L/m2 of fresh water per day withthe addition of a 6m2 (PV/T) panel, with an efficiency range of 65% to 90%. An averageof 2930 kJ/Kg of fresh water was determinedto be the specific energy feed.

Badran and Al-Tahaineh et. al. [9] added aflat plate collector to a traditional passive solar still and recorded a 36%

increase in efficiency. a rise in output.

El-Sebaii et. al. [10] We combined a single effect solar still with a shallow solar pond (SSP) in order to boost the daily production. As a result, we found that the daily output andefficiency of the still with the SSP were, on average, 52.36% and 43.80% higher than those achieved without the SSP, respectively.

Shankar and Kumar [11] investigated the effects of climatic factors, design considerations, and operational considerations on the instantaneous energeticand exegetical efficiencies of a single slop passive solar still and found that the instantaneous energy efficiency increases from 0.4 to 10.7% with an increase in value from 0.014 to 0.115, decreases by 21.8% and36.7% respectively with a decrease in absorptive of basin liner from 0.9 to 0.6, andincreasesmarginal.

Arjunan et. al. [12] analysed the solar situation in India and came to the conclusionthat the country, which is tropical, receives anaverage daily With 250 to 300 bright sunny days per year, different regions of the country experience solar radiation between 4 and 7 kWh per square metre. receiving around 5000trillion kWh of sun radiation every year as a result. The most appealing and straightforward method, especially for small-scale units, is solar distillation. Conventional desalination techniques harm the environment by utilising high grade conventional electricity as well.

Suleiman and Tarawneh et. al. [13], In order to assess the performance of a double slope solar still, the water depth was varied, Researchers at Mutah University examined the productivity of soil with four different soil thicknesses (0.5 cm, 2 cm, 3 cm, and 4 cm) and salty water TDS of 5000 ppm under the same meteorological conditions, and theydiscovered that the productivity is greatly

influenced by the climatic, design, andoperating variables. While theperformance characteristics showed astrong correlation between the waterproductivity and the intensity of the incident solar radiation, the increased water productivity is also significantly impacted by the reduced water depth.

Medugu and Ndatuwong [14] developed a solar still, tested it in Mubi, Nigeria, and performed a heat transfer study theoretically.internal mass transfer systems, and this solarstill. The results of the theoretical analysis were then compared to the measured performance. They noticed that when solar radiation and feed water temperature rise, sotoo does the instantaneous efficiency. Thestill's distillation efficiency was 99.64% or higher, which was in direct conformity with the theoretical calculations.

Akash et. al. [15] the effectiveness of a double slope single basin solar still usingabsorbing materials in an effort to increase productivity and found that using absorbing black rubber mat increased distilled waterproduction by 38%, using black ink increasedproductivity by 45%, and using black dye (being the best absorbing material) increasedoutput by 60%. 2.1 LITERATURE GAP:

They have designed 14 litre capacity solar water distiller and we have designed for a capacity of 20 litres. As per the literature review 14 litre can produce 1.5 litres of purewater and by our calculations 20 litres can produce more than 2 litres. We can’t take more water as due to oxidation; formation of fungus can occur and this will lead the water to stink and have bad smell. And the estimation cost of the researchers was 15 thousand and we can do it in 13 thousand because They have used black silica as basematerial and we are using the tar as our basematerial as it is cheaper and can be used fora long time. We are using stainless steel as it is much cheaper, Durable, corrosion resistant and high strength.

3. BASIC PRINCIPLE OFSOLAR STILL:

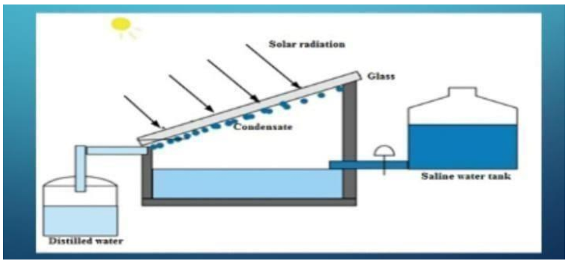

Figure 1: Simple water distillation process.

The fundamentals of solar water distillation are straight forward butefficient since distillation mimics how rain falls in nature. The energy from the sun heats water to the point of evaporation. Asit evaporates and condenses on the glass' surface for collecting, water vapour rises. Through this process, microbiological organisms and contaminants like salts andheavy metals are removed. The water produced by the solar water distiller iseven purer than the best.

rain-generated power.

4. Solar Still Operation:

The still is filled with cleaning water until thebasin is halfway full. Solar radiation can enterthe still through the glass top, but is primarilyabsorbed by the base's blackened surface. Toincrease solar absorption, this inside surface is made of a substance that has beenblackened. As the water warms up, the amount of moisture in the air that is trapped between the water's surface and the glass lid rises. The glass cover's inside becomes condensed with the heated water vapour thathad been evaporating from the basin. At this stage, The original water's minerals and microorganisms are not removed. Condensedwater drips from an inner collection trough and out to a storage bottle through an inclinedglass lid. For effective cleaning of the basin water and to remove extra salts left over fromthe evaporation process, feed water that roughly exceeds distillate production should be added each day. If the still produced 3 litres of water, 9 litres of makeup water should be added; the remaining 6 litres should be left in the still as extra to flush the sink.

5. Solar distillation plant design:

5.1 Developing of solar still:

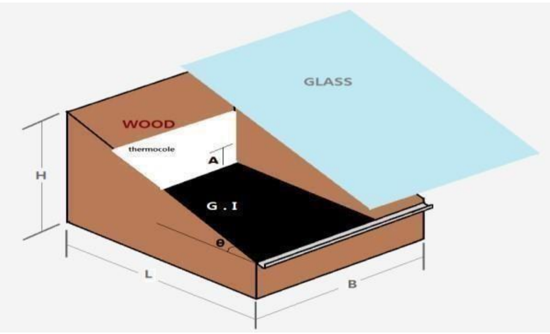

Figure.2 Solar Distillation System of the model. The base of the solar still is constructed from a G.I. box that is 4'x 3 x 10 cm in size.A second wooden box is inserted with this one in Image 2. Here, the dimensions are asfollows: length L=64 cm, breath B=124 cm,height H=30 cm, opposite side =13 cm, andangle =154. Between the G.I. box and the

wooden box, this also has a thermocol boxwith in. The thickness of the is 16 cm. Thechannel is set in a way that water that is slipping off of glass will fall into it as a result of gravity. The wooden box is fastened with a frame made of fibre sticks so that glass can rest on it. The model's creation is now complete. According to convenience, holes have been built for the water's input, brackish water's outlet, and pure water's outlet. We the inlet of the right wall above is the outlet, the outlet of brackish water at the right bottom of the model (as seen from the front), and theoutlet of pure distiller water at the end of the channel.

Still Basin:

The system's component where the water thatwill be distilled is kept is this one. It must consequently be able to absorb solar energy. Thus, it is essential that the material has strong absorption or very low reflection and transmittance. These are the standards forchoosing the materials for basins. The following types of basin materials are available: Leather sheet, Ge silicon, mild steel plate, and RPF are the following: (reinforced plastic) 5. G.I. (galvanised iron) (galvanised iron).

5.2 Side Walls:

In general, it gives the still rigidity. However,in terms of technicality, it offers thermal resistance to the heat transfer that occurs fromthe a system to the environment. In order to support its own weight as well as the weight of the top cover, it must be composed of a material with a low thermal conductivity value (refer fig.no.2).Ones that can be used include: 1) wood, 2) concrete, 3) thermocol, and 4) RPF (reinforced plastic). We used a composite wall made of wood on the outside and thermocol on the interior for improved insulation. Wood is 8 mm thick (k=thermal conductivity=0.6 W/m 0C) and water thermalinsulation is 15 mm thick (k=thermal conductivity=0.02 W/m 0C). : Supports for Top Cover:

Figure.3 Working model of solar distillationsystem.

The top cover's supporting structure is anoptional addition. It can therefore be employed if necessary. Fiber stick hasbeen used by us as a aid for holding glass(size: 5 mm X 5mm). The only modification to our model is the requirement to make it as vacuumed as feasible. There fore, we made an effort tokeep it airtight by applying tape to the glass's corners and the box's edges, whichare the most likely places for hot air frominside to escape out. The primary factors in the design of these solar desalination systems are the cost, efficiency, convenience of building, and availability of materials. Figure 3 presents aschematic. Slabs of 1.5-inch-thick polystyrene foam were used to build the basin's base and side walls.

6. DESIGN OF SOLAR STILL:

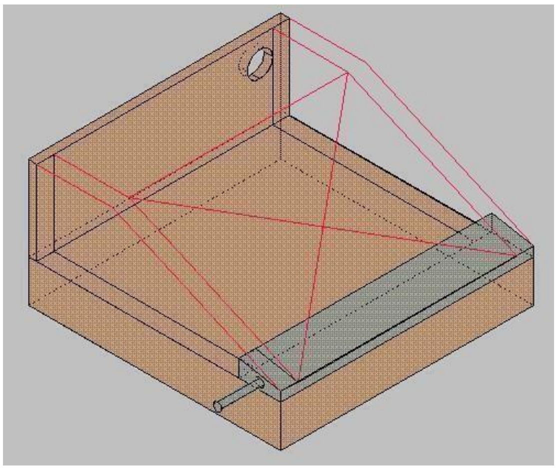

Figure.4: Schematic diagram of solar distillationdevice.

The solar-powered prototype wasnevertheless constructed from affordablecomponents. This device's operation is straightforward. The distinctive quality of this gadget is special. It has unique features like a water depth regulation mechanism anda modular architecture. The basin region, which is the first part of the solar still device, is where solar energy is absorbed to create heat. the vicinity of basin is dependent on theintended result. Typically, it is advised togenerate 2 to 5 gallons of water. Thermal circuit was created to determine basin size (refer to Section 4).

7. DESIGN:

within the distiller to speed up evaporation atcooler temperatures and hence boost productivity. Just one more thing. Thedistiller we're suggesting has the ability to heat water at a lower temperature using latent heat that is released during condensation. This is accomplished through the use of a creative staged still design. The basic configuration of the system is as follows;however, before moving on, we'd like to mention a few assumptions that we made forthe Design. The working pressure needs to bedecreased: The figure is taken to represent thetypical size of a rural household. The census statistics have also been used to confirm data.The solar constant is 1.4 kW/m2, but becauseof losses caused by the atmosphere, we can think of the 1.1kW/m2 of solar radiation is expected. Water has a specific heat of 4.2 kJ/kg. 2260 kJ/kg is the difference between the latent heats of condensation andvaporisation. Low heat transfer losses areensured by using a manually driven vacuumpump to lower air pressure inside thedistillation chamber at operating temperatures of roughly 60oC. Water has a 20 kPa vapour pressure at 60 degrees Celsius.A conversion efficiency of only about 20%. Aperture Area = Energy needed to distil 10 litres of water/ Solar energy = Available per m3 * Conversion efficiency = (11 kg/day) * 4.3kJ/kg 0C * (60-30) 0C/ (1.1 kW/m2 * 3650 s/hour *6 hours/day) *(0.2) = 0.266 m2Therefore, the distillation process requires a total area of 0.26 m2.

8. OBSERVATIONS:

One hour is needed for the drop to enter thecanal. It takes a drop 30 minutes to escape the channel. The initial brackish water inputis 14 litres. 1.5 litres of pure water were obtained at the experiment's conclusion.The condensate's temperature is 29 degrees.Pure water has a TDS of 81 ppm.

9. RESULT OF SOLAR STILL: The amount of water in the tank and theamount of solar radiation affect howmuch distilled water is produced. theradiation when increases in both outputand output.

The amount of water in the tank and solar radiation are inversely related. Theproportion of water vaporisation energy tolatent heat of vaporisation still determines the daily solar output. Solar still

OVERALL = Solar Energy's overall efficiency. hv = the vaporization's enthalpy

A = Basin area

Water output is MOUT.

10. CONCLUSION:

The basic need for all of us to live normally on earth are water and energy. Solar energy islimitless, abundant, and cost-free. in additionto being green. For emerging and poor nations to meet their energy needs, the tech based on solar energy is complicated. One ofthe best uses of renewable energy in daily lifeis the use of solar energy in distillation. The best output produced by stills is solardistillation, which is also the most user friendly in terms of operation, maintenance, MOUT=OVERALLGA/hv repair. the creation of a solar-powered alternative for tiny communities that have trouble accessingclean water. For solar powered water distillation to be as effective as possible, efficient functioning is required. The optimization of several distillation processparameters is examined in this research. Thissuggests that March and April are the monthswith the highest output. The need for drinkable water continues to be one of the world's most pressing problems, and solardistillation provides significant and practicalsolutions. Low-cost solar stills provide quickand efficient answers for supplying safe distillation water consistently year after year.Single-basin solar stills are simple to construct, cheap, and very efficient in distilling water with a high total dissolved salt content and at eliminatingmicroorganisms like cholera and E. Coli. Based on tried-and-true solar still designs, single basin solar stills can be constructed with readily accessible hardware. The amount of water produced on average per square metre each solar hour is 0.5 litres.

Solar stills can help consumers immediately by resolving long-term issues brought on by water-borne illnesses. Solar stills are the only practicaloption.

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