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"Double Slope Solar Still With External Flat Plate Reflector"

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Abstract — The purpose is to design a water distillation system that can purify water from nearly any source, a system that is relatively cheap, portable, and depends only on renewable solar.This paper is based on to production of clean drinkable water from solar energy. Distillation is one of many processes that can be used for water purification. When Solar energy is used for this purpose, it is known as Solar water Distillation. However, the coming shortage in fossil fuel supply and the growing need for fresh water in order to support increasing water and irrigation needs, have motivated further development of water desalination and purification by renewable energies.

Keywords- Solar distillation, Solar Still, Evaporation, Potable water, Reflector

I. INTRODUCTION

The basic principles of solar water distillation are simple yet effective, as distillation replicates the way nature makes rain. The sun's energy heats water to the point of evaporation. As the water evaporates, water vapour rises, condensing on the glass surface for collection. This process removes impurities such as salts and heavy metals as well as eliminates microbiological organisms. The end result is water cleaner than the purest rainwater. Due to ecological issues and limited fossil fuel resources, more and more attention is being given to renewable energy sources. In the recent years solar energy has been powerfully promoted as a feasible energy source. Solar energy is a very large, unlimited source of energy. The power from the sun intercepted by the earth is approximately 1.8×1011mw, which is many thousands times larger than the present all commercial energy consumption rate on the earth. Therefore, solar energy could supply all the present and future energy needs of the world on a continuous basis. This makes it one of the most promising of all the unconventional energy sources. in addition to its size, solar energy has two other factors in its favor. Initially unlike fossil fuels and nuclear power, it is an environmentally clean source of energy. Secondly, it is free and available in sufficient quantity.

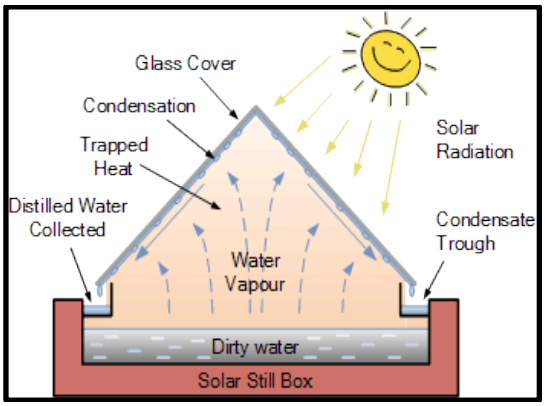


Figure1. Solar Still Diagram

II. APPLICATION OF SOLAR STILL

Solar stills are used in cases where pipe or well water is not available properly, such as in remote homes. In subtropical hurricane target can lose power for days in that area solar distillation can provide an alternative source of clean water. Solar distillation is a proven technology for water disinfection. Systems can be sized for one person, up to community sized systems. They have no moving parts, relying only on the sun for energy, and should last 20 years or more. Larger disinfecting systems which generate contaminated water, solar still can be to distil water and can used in various places. Solar still can be used in industries where waste or contaminated water and this distilled water can be used in industries for other industrial purposes. By constructing many solar stills of similar types it can in agriculture purpose. Some applications in industries like cooling purposes, sea water is feasible despite the corrosion problems while other industries use higher quality water than is acceptable for drinking water. Modern steam power generation plant needs water with less than 10 ppm. Solar still can be used in small household purposes.The energy from the sun used to distill water is free. But the cost of building a still makes the cost of the distilled water rather high, at least for large-scale uses such as agriculture and flushing away wastes in industry and homes. Consequently, the solar still is used principally to purify water for drinking and for some business, industry, laboratory, and green-house applications. It also appears able to purify polluted water.

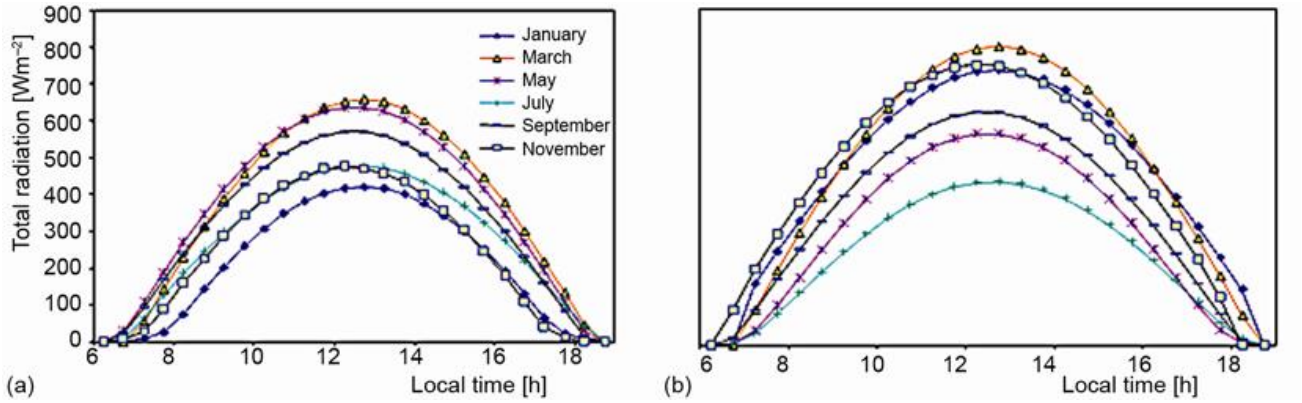


Figure 2- The total solar irradiance on north and south covers as a function of local time for various Months for the year 2008

Thermal loss factors

Production is also associated with the thermal efficiency of the still itself. This efficiency may range from 30 to 60 percent, depending on still construction, ambient temperatures, wind velocity, and solar energy availability. Thermal losses for a typical still vary by season, as shown in Table 1.

Table1. Distribution of Incoming Solar Radiation in the Distillation Process

Thermal loss Factor	**December %**	**May%**
Reflection by glass	11.8	11.8
Absorption by glass	4.1	4.4
Radiative loss from water	36.0	16.9
Internal air circulation	13.6	8.4
Ground and edge loss	2.1	3.5
Re-evaporation and shading	7.9	14.5

III. MAJOR COMPONENTS OF SOLAR STILL

Solar still is a simple device that can change available water or salty water into portable water by using solar energy. Main components of solar still are:

3.1 OuterBasin: It is the part of the system in which the water to be distilled is kept. It is therefore essential that it must absorb solar energy. Hence, it is necessary that the material has high absorptivity or very less reflectivity and very less transitivity. These are the criteria for selecting the basin materials.

3.2Inner Basin: Solar radiation transmitted through transparent cover is absorbed in the black lining. Black bodies are good absorbers. Black paints used as liner.

3.3Top Cover: Glazing glass is used. The use of glass is because of its inherent property of producing greenhouse effect inside the still. Glass transmits over 90% of incident radiation in the visible range.

3.4Condensate Channel: It is the part of the system in which condensed water is collected. Sheet of required measurement is first cut out, and then it is folded by using the folding machine.

3.5Supply & Delivery System: Three holes are made in the basin, one for supply and two for delivery.

3.6Insulation: Thermocol/PUF used as insulator to provide thermal resistance to the heat transfers that takes place from the system to the surrounding

3.7Sealant: M-seal and putty is used as sealant to make the distiller leak proof and air tight. In addition, UV Glue is used to join Metal to Glass. Silicon Glue is used to join Glass to Glass.

3.8Table: Pine wood table is used to support whole setup. Pine wood has good surface finish. Base of Plywood is used because of its good strength.

3.9Reflector: Reflecting Mirror is used with one side silver coated and is supported by plywood to prevent its rupture.

IV. MATERIAL SELECTION

4.1 Basin: The basin materials that can be used are as follows:

1. Leather sheet
2. Ge silicon
3. Mild steel plate
4. RPF (reinforced plastic)
5. G.I. (galvanised iron**)**

G.I. is cheap and long life and also has good properties therefore we are selecting G.I. for basin material**.**

4.2 Side Walls: For this, he material that is having low value of thermal conductivity and should be rigid enough to sustain its own weight. Different kinds of materials that can be used are Wood, Concrete, Thermocol. Out of this all, Wood has good thermal conductivity rather than any tool therefore we have selected wood.

4.3 Top Cover: The material for top cover should be: 1) Transparent to solar radiation, 2) Non-absorbent and non-adsorbent of water, 3) Clean and smooth surface. Toughened glass has more hardness and less breakage compare to normal window glass therefore we have selected toughened glass.

4.4 Channel: The condensate that is formed slides over the inclined to cover and falls in the passage, this passage which fetches out the pure water is called channel. The materials that can be used are:

1) P.V.C.
2) G.I.

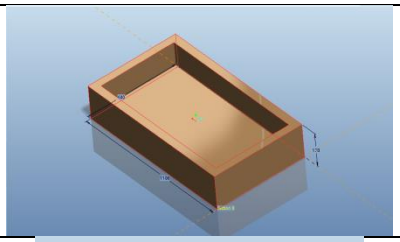
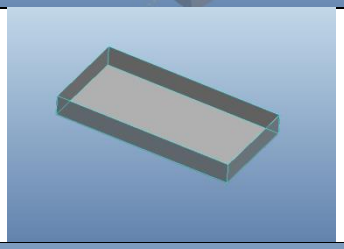
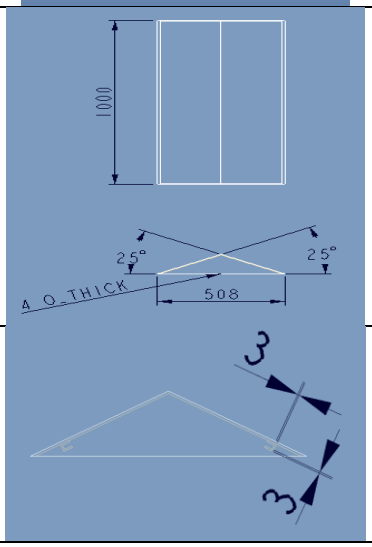
For channel to resist heat and get clean water PVC the best material.

4.5 Supports for Top Cover: The frame provided for supporting the top cover is an optional thing. I.e. it can be used if required. We have used fibre stick as a support to hold glass

V. DESIGN OF SOLAR STILL

The solar still is consists mainly of a rectangular shaped with black painted basin surfaces. The still basin is used to magnify the amount of solar energy absorbed to increase the quantity of distilled water produced. The single basin double slope solar still has been fabricated with galvanized iron plate.The overall size of the inner basin is 1000 mm x 500 mm x 120 mm and that of the outer basin is 1100 mm x 600 mm x 170 mm. The gap between the inner and outer basin is packed with wood chips as insulation material to reduce the heat loss from the inner basin to the outlet. The frame of the outer basin is made of wood sheets. The top condensing cover is consists of glasses sheets of thickness 4 mm inclined at 25° on both sides.

Table 2.Components Specifications

Components	Dimensions	Material	3D – CAD models
Outer Basin	1100*600*170 Thickness : 5mm	Wood	
Inner Basin	1000*500*120 Thickness : 3mm	GI sheet	
Glass	Thickness: 4mm Glass angle =25°	Toughened glass	
Condensate Channel	Thickness: 4 mm	Aluminum	

Final assembly of solar still:

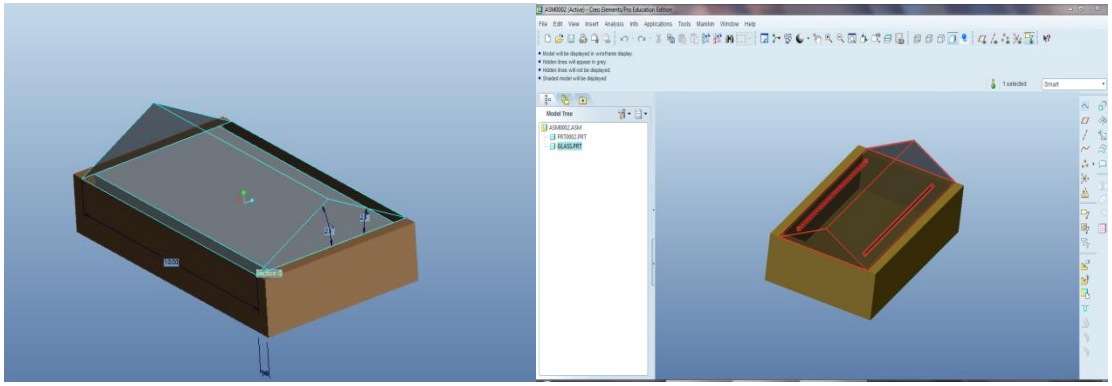


Figure 3. 3D – CAD model of double slop solar still

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