

SPECIMEN FORMAT FOR THESES OF MONTH

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Branch/ Area: : Solar Energy

Sub Subject Heading: : Solar Energy

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Title of the thesis : Construction and Performance Analysis of a Single Slope and a Pyramid Cover Solar Sill with Storage media and Electrical Backup

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Designation of Supervisor : Professor (Rtd)

Centre/department/school in which research was conducted : Avinashilingam University

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Abstract within 300 words: enclosed

The Main objectives

- a) To construct a Single Slope and Pyramid Solar Stills.
- b) To study the individual thermal performance of the Single Slope and Pyramid Solar Still.
- c) To analyse the thermal performance of the two stills (Single Slope and Pyramid Solar Still) with thermal storage medium such as Tar Coated Blue Metal absorber.
- d) To analyse the thermal performance of the two stills (Single Slope and Pyramid Solar Still) with with Phase change material (Wax).
- e) To analyse the thermal performance of the Pyramid Solar Still coupled with electrical back up.
- f) To study the instantaneous and over-all efficiencies of these two stills (Single Slope and Pyramid Solar Still).
- g) To develop a simulation model for the solar still.
- h) To analyse the internal and external heat transfer modes for individual and combined with absorbing materials.
- i) To analyse the thermo-physical properties of water in all performance studies.
- j) To analyse the behaviour of Nusselt, Grashof, Prandtl and Rayleigh Numbers in all performance studies.
- k) To analyse improvement in distilled yield in the two stills (Single Slope and Pyramid Solar Still) performance.

Methodology:

Construction of Single Sloped Solar Still

The water storage basin of the single sloped solar still is constructed of dimension 0.75m x 0.75m using stainless steel. The $\frac{1}{4}$ inch pipe provision is provided for pouring water to the still. The outlet pipe is provided at the tapering end of top cover side. Another pair of pipes at a height of 0.18m

and 0.22m is provided at the sides of the still to insert thermocouples. Outer box for this still is made up of wood of thickness 4mm. It is filled with saw dust and glass wool to minimize bottom and side loss. 3 mm glass of area 0.75m x 0.75m is used as top glass cover for the still with 11° slope is placed over the grooves provided at all sides for uniform resting. Water Collection segment is placed at the end of the still for collecting the evaporated water and it is of dimension 0.85m x 0.02m x 0.015m.

Construction of Pyramid Solar Still

The water storage basin of pyramid solar still is made up of stainless steel of dimension 0.75m x 0.75m x 0.15m. The top cover of solar still made up of glass plate of 3mm thickness. In this system the top cover is arranged for the suitable slope of 11° at four sides of the basin. Inlet and outlet pipes are placed diagonally opposite to each other. A separate provision for filling water to the still is provided at one side of the basin. The stainless steel is bent in the 'U' strip of dimension 0.85m x 0.02m x 0.015m and is provided at the top edge of four sides of basin to collect the condensed water from the slope of acrylic cover that is evaporated as a result of heating. Two outlets are located at diagonally opposite to each other to collect distilled water. 4mm thickness wood is used to construct the outer cover box. Side loss and bottom loss in still are minimized by using glass wool and sawdust in outer cover box.

Construction of Temperature Controller Circuit

Electrical backup is made using the circuit comprising of temperature controller. Here external temperature controller is connected in between the one side of the coil to control the temperature in it.

Water temperature can be varied by adjusting the input values of the temperature controller. Once if the fixed temperature is attained, circuit opens, hence the flow of current is prevented, which results in halt of heat produced in water. When the water temperature drops below the fixed temperature, circuit is switched on and it results in heating of water.

Thus temperature controller circuit switches on and off when the water temperature neutralizes or falls below the fixed temperature. As a result water is maintained at uniform temperature.

Simulation model developed for solar still with appropriate energy balance equations and boundary conditions is discussed in Chapter 3.

Combined performance study of Single Sloped Solar Still in three different modes (still alone, with charcoal absorber, with wax medium) of study is discussed in Chapter 4. Initially the still performance is analysed individually and then the combined effect of thermal storage medium is studied. Next the combined effect of phase change material on the productivity of distillate yield is studied. Instantaneous efficiency, overall efficiency, average incident solar radiation, daily distillate yield, internal heat transfer values, external heat transfer values, dimensionless numbers, thermophysical properties, performance ratio and saturated vapour pressure are predicted for Single Sloped Solar Still. In combined performance study of Single Sloped Solar Still with thermal storage medium. Same procedure for the performance analysis of combined thermal storage medium with still is adopted for phase change material combined with Single Sloped Solar Still.

The combined performance study of Pyramid Solar Still in three modes (still alone, with charcoal absorber, with wax medium) is discussed in Chapter 4. After individual study still performance alone is analysed, Pyramid still is coupled with thermal storage medium and its performance is studied. Next the study is conducted by combining Pyramid still with phase change material to analyse the combined effect influence on the productivity of distillate yield. From the results of both studies, instantaneous efficiency, overall efficiency, average incident solar radiation, daily distillate yield, internal heat transfer values, external heat transfer values, dimensionless numbers, thermophysical properties, performance ratio and saturated vapour pressure are compared for all the mode of study in case of Pyramid Solar Still.

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