Review Paper on Solar Still with Bitumenasa Phase Change Material for Water Distillation

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Abstract
Water is basic necessity of man. Fresh water sources are considered to be rivers, lakes and underground water reservoirs. Although, more than two-third of the earth is covered with water and remaining of the earth is land. However, the use of water from such sources is always not good, because of the polluted environment. In present work phase change material(Bitumen) is used to store the solar thermal energy in the form of latent heat, which can offer high storage capacity per unit volume and per unit mass and we can get heat in the night time for desalination. The efficiency of the solar still without PCM is about 25.19% and in presence of PCM (Bitumen) will rises.

Keywords- Bitumen, Desalination, latent heat, PCM, Solar energy, Solar still.

1. Introduction

A Solar Still is a device that produces clean, drinkable water from dirty water using the energy from the sun as shown in fig.1.This inexpensive device can easily be built using local materials. Presently, basin type solar still is the only device that is being used for water distillation applications. Solar distillation is very old technology. It is simple treatment for water purification. The basic principles of solar distillation areyet effective, the heat of the sun evaporates the water and the vapor condenses on inner surface of the cover. The condensate runs into trough from which it can be collected in storage containers. The solar still is Non-conventional, cheap, simple, easy to construct and is of low thermal capacity.

Water purification is a very broad subject matter and can generally be defined as the removal of contaminates from water in order to make it suitable for a certain use. Water purification can include the decontamination of surface and ground water from sources such as lakes and streams but also includes reclamation from wastewater sources .Under these circumstances, latent heat storage (LHS) has attracted considerable attention. LHS is based on the storage or release of latent heat when a phase change material (PCM) undergoes a phase transition from solid to solid, solid to liquid, or vice versa

2) Objectives

1) Study the performance of solar still for water purification through bitumen as a pcm

2) To enhance the efficiency of water purification

3) To comparison with other pcm materials

4) To utilize in mobile area for water purification

5) Toprovide a potable water through this method

Solar still operation- A solar still used for converting brackish/saline water into potable water using solar energy is called solar still. It consists of a shallow blackened basin of saline water covered with a sloping transparent roof. Solar radiation that passes through the transparent roof heats the water in the blackened basin, thus evaporating the water which gets condensed at underside of the glass and gets collected in the tray as distillate attached to the glass. In present project a phase changing material is placed at the bottom of the water tray which is in contact with the water tray at the bottom and helps in evaporation by liberating heat after sunset.

3. **Experimental setup**: The present project consist as an equipment called solar still, which consist of a basin made up of tin of 0.54 m2 area, having a length of 90cm and 60cm width with 30 cm height. Inside this basin another basin is placed with a distance of 8cm leaving a gap from bottom and sides and in between this gap an insulation material (glass wool) is placed to prevent loss of heat. The inner box is filled with phase changing material (PCM) with a thickness of 7cm, here the PCM used is Bitumen which will change their phase from solid to liquid during day time and liquid to solid in the night, above the PCM a 2, 4 and 6cm height of saline water is filled which will evaporate when gets heated by solar radiation. At the top of the basin a transparent glass is placed at an inclination of 23deg which is having a thickness of 3mm which will allow the solar radiation to enter into basin consisting of water. When water gets heated it starts evaporating and collects at the underside of the glass cover as vapors. This collected vapors move on to the condensate channel which is provided inside the basin. The basin also consists of one inlet at the rear end for water input and two outlets at front end to collect the water from two condensate channels. In addition to this certain important parameters are to measured simultaneously which are temperature, global solar radiation, wind speed and humidity and these are measured using thermometer, Pyranometer, anemometer respectively.

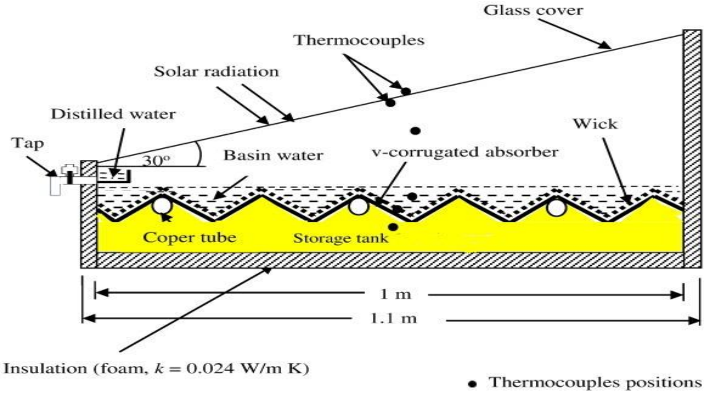

fig 1

4. Literature Review

Thermal and optical aspect of PCM interior and exterior shading devices and integrated PCM-glazed systems were studied using experimental and numerical method.

Interior PCM-shading systems were studied mainly by using experimental methods. Weinlaeder *et al*. investigated thermal aspect of PCM-filled vertical slats. Mehling presented the application of the PCM in the interior horizontal blinds applying hydrated salt. Result show that temperature variation is reduced for 2°C and the attenuation effect on the interior air temperature is observed with the help of PCM sun shading system. The main drawback of interior shading devices with PCM is delayed heat gain to the interior in which all accumulated heat enters the interior.

Exterior PCM-shading systems were studied by using numerical and experimental methods. Alawadhi in his study used a finite element model for numerical simulations of heat transfer in a window with exterior shutter containing PCM. Soares *et al*. used two dimensional numerical simulation models for analysis a southward PCM shutters system for winter mode. Exterior window shading elements with PCMs were also studied by Buddhi *et al*. They study the thermal performance of a wooden box having a PCM window in south direction. Experimental study using full scale window shutter with PCM also show potential for the thermal regulation of indoor spaces. Main drawback of exterior shading solutions is highly reduced light to the interior.

As integrated PCM-shading system, Merker *et al*. have published results of shading system development of a new PCM-shading system to avoid overheating around the window area. Similarly, Ismail and Henriquez studied the possibility of using a window with a movable PCM curtain. They performed numerical and experimental study for double glazed windows using PCM in the cavity. The system is dependant of pump, controller and electricity. Due to many components included in the window system it may be expensive and complicated to operate for end user. Goia *et al*conducted experimental studies to assess of the thermal behavior of a PCM glazed system, and used basic numerical model for simulation of different configurations of PCM glazed system, The results presented show that thermal comfort can be improved Also, degradation of PCM applied in full scale glazed system may happen due to thermal cycling

Performance assessment of a novel window system design based on PCM and its ability of reducing temperature variation are subject of this research. The significance of research is reflected in the contribution to the development of temperature-responsive window system based on the energy storage with the aim of reducing building cooling demand. Having in mind the advantages offered by PCM window systems in terms of storing and releasing of the heat, it is found worthily of attention to investigate this subject in terms of impact of cavity layer thickness to A/C unloads hours and recommend suitable cavity for the window exposed to radiative environment and environment with no radiation.

5. Problem description

The needs for this study are reflected in its contribution to the development of environmentally responsive building components [2] based on the energy storage that will reduce building energy demand and foster passive design strategies.

The previous studies were focused on possibilities of application of the PCM in interior, exterior and integrated shading devices. The solutions offered were not optimized and it is difficult to draw conclusions from the studies about optimum thickness of the PCM layer in the glazing system and its limitation factors. Therefore, the submitted work extends the previous studies related to integrated glazing solutions; in particular investigates impact of the cavity thickness to the glazing system performances using experimental and numerical methods.

6. ProposedDesign

For the proposed design, pictured in figure 2, a passive wick-based solar still, paired with a solar collector was chosen for its simplicity and effectiveness. The lack of moving parts (except for one pump) limits the complexity of its construction and the need for maintenance. Water is pumped from the untreated water vessel into the bottom of the solar collector. Then, heated by the sun, the water moves upwards due to decreased density. The heated water moves out of the solar collector into the wick still where a nozzle distributes the water evenly over the wick. Some of the water evaporates and is moved into the distillate vessel by means of a distillate trough. The rest of the water is heated passively by the sun on its way down the wick. The reheated water exits the still via gravity where it passes through a heat exchanger storing its heat in a PCM. The now cooled water returns to the untreated water vessel to recirculate through the system. The PCM is ideally situated to continue heating the water when solar power is not available. This system should continue to be productive for some time into the night and during cloudy weather. The wick-based still will be very similar in design to that developed by Aybar, Egelioglu, and Atikol

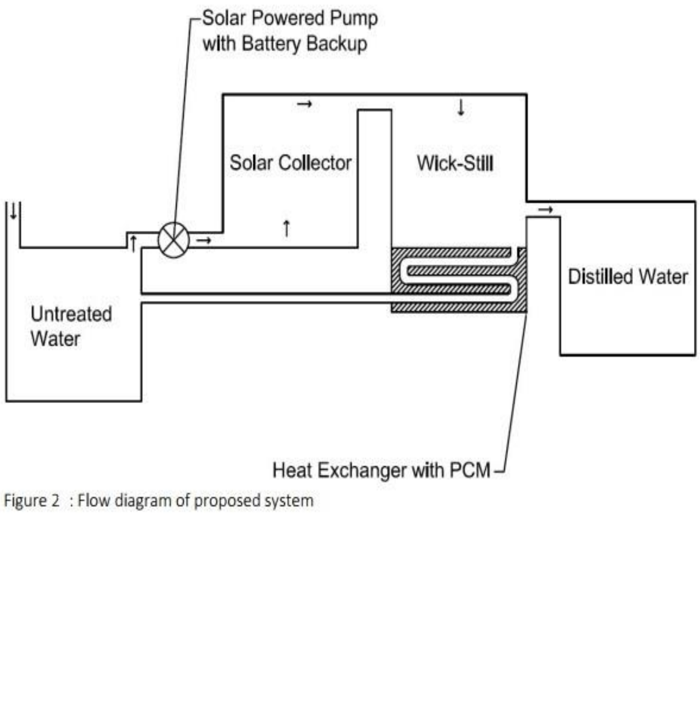

Figure 2 : Flow diagram of proposed system

6. Conclusion

Solar power is a plentiful and environmentally friendly source of energy. With the increasing scarcity of drinkable water, it is only logical to pursue methods of water purification that employ solar power and other forms of renewable energy. While many forms of solarpowered water purification have been developed, one of the simplest and most reliable is distillation. The efficiency of distillation is greatly increased with the introduction of a wick, but solar-powered distillation can be further improved with the use of PCM energy storage.

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