# Experimental Investigation of Solar Desalination Using Cetyl Alcohol

[1]A.Srisakthi, [2]V.R.Bala Kumar, [3]S.Suyambu lingam
[1,2,3]Dept. of ME, Veltech Hightech Dr. Rangarajan Dr. Sakunthala Engineering College, Chennai, Tamilnadu, India

**Abstract**
Water is a renewable resource as well as the finite resource. It is important to appreciate the fact that 97% of water is inaccessible and only 3% is fresh water. It is the human nature that we value things only when they are scarce or are in short supply. We appreciate the value of water only if rivers, reservoirs, ponds, wells, etc. run dry out of water. Our water resources have now entered an era of scarcity. World Bank estimates that 21% of communicable diseases in India are related to unsafe water. There are various technologies available for purification of water, distillation is one of the many process available for water purification and Solar energy is used to energize the process. The solar Energy increases evaporation rate. As the water evaporates, water vapour sticks to the underside of the glass surface for collection as distillate. PCM materials have high heats of fusion so they can absorb a lot of energy before melting or solidifying and thus enhances the productivity of water. In this study, a basin type solar still was designed and fabricated. Experiment was carried out at 2cm water depth of basin which is maintained inside solar still and the productivity is increased by using the PCM.

**Keywords**
Desalination, Solar Still, Cetyl Alcohol

## I. Introduction

Water is our lifeline that bathes us and feeds us. Water is the foundation of life. And still today, all around the world, far too many people spend their entire day searching for it. There is almost no water left on Earth that is safe to drink without purification. The main source of water is lakes and rivers. Before it is delivered to home which should be treated to remove chemicals and bacteria. For this reason, purification of water supplies is extremely important.

Moreover, typical purification systems are easily damaged or compromised by disasters, natural or otherwise. This results in a very challenging situation for individuals trying to prepare for such situations, and keep themselves and their families safe from the myriad diseases and toxic chemicals present in untreated water.

Everyone wants to find out the solution of above problem with the available sources of energy in order to achieve pure water. Fortunately there is a solution to these problems It is a technology that is not only capable of removing a very wide variety of contaminants in just one step, but is simple, cost-effective, and environmentally friendly. That is use of solar energy. We are going to use this solar energy for desalination and we are going to use PCMs to improve the efficiency.

**Properties of Cetyl Alcohol:**

| | |
|---|---|
| Appearance | White crystals or flakes |
| Odor | very faint |
| Molar mass | 242.45 g·mol$^{-1}$ |
| Refractive Index($n_D$) | 1.4283 (79 °C) |
| Flash point | 185 °C |
| Density | 0.811 g/cm$^3$ |
| Melting point | 49.3 °C |
| Boiling point | 344 °C |
| Latent Heat of Fusion | 141.8 KJ/Kg |
| Solubility in water | Insoluble. |

## II. Experimental Setup

Solar still operation 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 the blackened basin and evaporates the water which gets condensed at underside of the glass and gets collected in the tray as the distillate attached to the glass.

**Dimensions of Solar Still**

| Parameter | Values |
|---|---|
| Inner area of solar still | 1.5696m$^2$ |
| Outer area of solar still | 1.7848 m$^2$ |
| Inclination Angle | 10.20$^0$ |
| Lower end height | 0.14m |
| Higher end height | 0.32m |
| Insulation thickness | 0.5inch |

The experiments are carried out from morning 9 am to next day morning 9 am for with conventional solar still and from morning 9 am to next day morning 9 am for PCM. The various temperatures with respect to time and the water output/hr are noted down

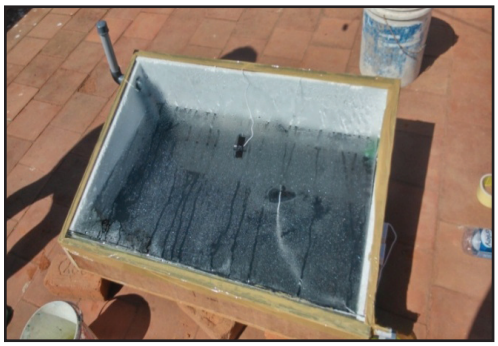

Fig. 1: Conventional Solar Still

Fig. 2: Solar Still With PCM

The experiments are carried out by keeping the input water as constant. The experiments are started at morning 9am and continued till next day morning 9 am. The water is poured up to 2cm height of basin by the way nearly the input quantity of saline water is 10lit. The inner glass surface temperature (T1), water temperature and basin temperature (T2, T3), outer glass surface temperature (T4), PCM temperature1 (T5) and PCM temperature 2(T6) are noted. Before starting the experiments have to check that the drain pipe is closed properly or not and the insulation is properly done. If there is poor insulation it leads loss of productivity. Every 1hr these temperatures should be noted and the collected pure water should be measured. By doing experiments the productivity of pure water is higher

## III. Results and Discussion

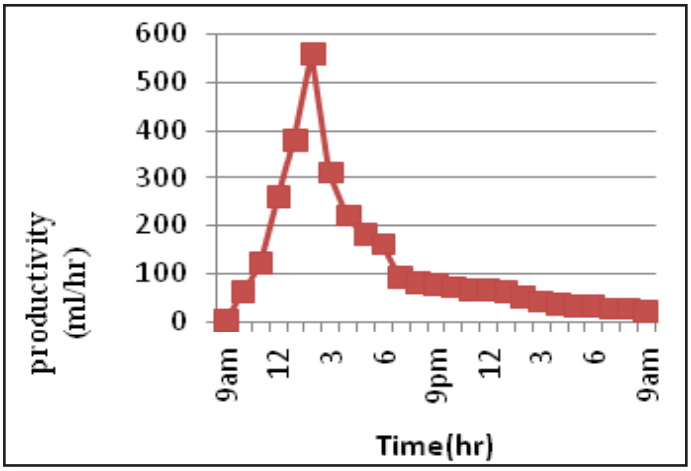


Fig. 3: Productivity With Respect to Time

The fig. 3 shows the water output with respect to time. At the starting
Time at 9.00 am the water output is 0ml. From 2.00pm onwards the output quantity is getting raised the reason is the solar radiation getting raised due to the black paint coating leads to high absorption of heat and the productivity gradually decreases due to the reduction of solar radiation.

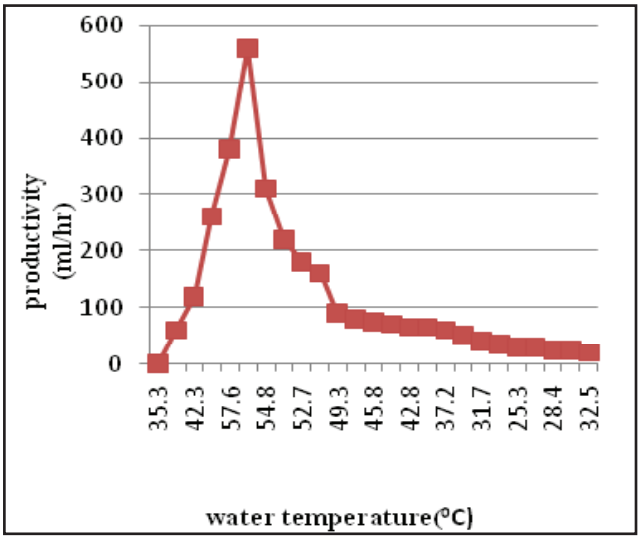


Fig. 4: Productivity With Respect to Water Temperature (With PCM (Cetyl Alcohol))

The fig. 4 shows the productivity with respect to water temperature. At initial temperature, water output is 0ml. And the overall output quantity is 3.01lit. By this graph we can find out that the PCM leads to increase in productivity. The maximum temperature absorbed by using the PCM is 60.5°C.

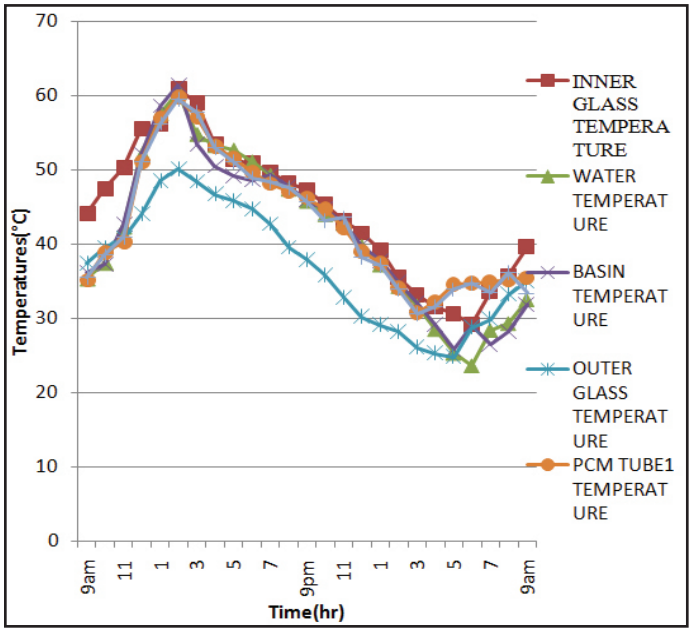


Fig. 5: Time With Respect to Different Temperature (With PCM (Cetyl Alcohol))

The fig. 5 shows the Time with respect to different temperature. The ambient temperature at the starting stage is nearly close to water temperature while the time increases the solar radiation gets increased and so the water temperature increases than the ambient temperature. so the productivity also increases.

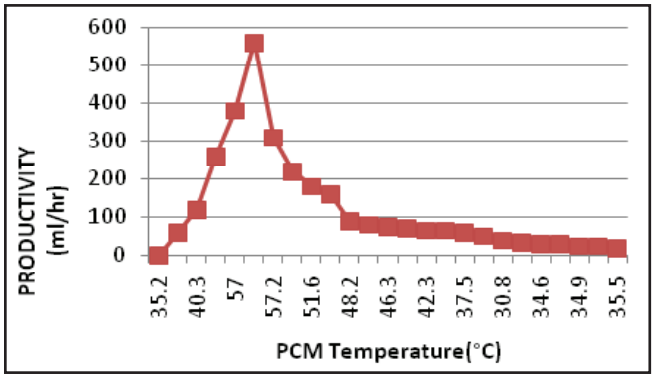


Fig. 6: Productivity With Respect to PCM Temperature (With PCM (Cetyl Alcohol))

The fig. 6 shows the productivity with respect to PCM temperature. By this graph we can find out that the PCM leads to increase in productivity. The maximum temperature absorbed by using the PCM is 60.5°C.

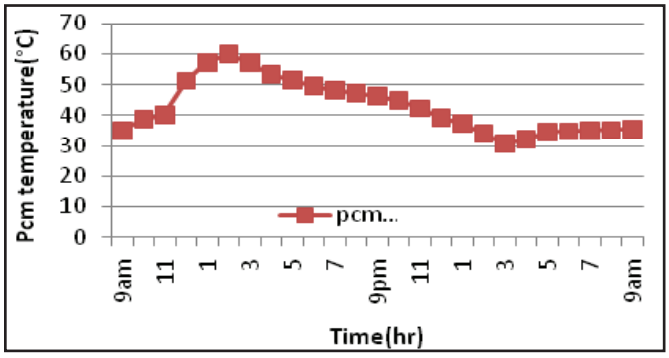


Fig. 7: Time With Respect to PCM Temperature

The fig. 7 shows the Time with respect to PCM temperature. The ambient temperature at the starting stage is nearly close to PCM temperature while the time increases the solar radiation gets increased and so the PCM temperature increases which results increase in productivity

## IV. Conclusion

1. While performing experiment with conventional solar still the productivity of pure water (1750ml) is found to be minimum.
2. When performing experiment with PCM (Cetyl Alcohol), the productivity is increased from 1750ml – 3010ml.
3. The productivity of water for cetyl alcohol is found increased 41.85% when compared to conventional solar still.

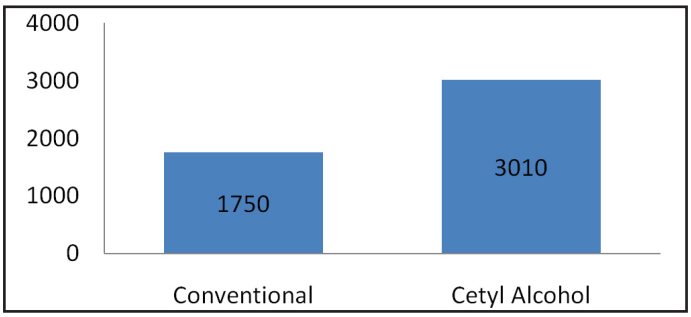


Fig. 8: Comparison Between Productivity of Water

## Reference

[1] Vidya Sagar Raju, R. Meenakshi Reddy, E. Siva Reddy, "Performance Evaluation of Solar Still – Steric Acid as a Pcm-R", G.Pulla Reddy Engineering College, Kurnool, A.P., India, International Journal of Engineering Research and Applications.Nov-Dec 2013.

[2] Kantesh.D.C.Angadi,"Design of solar still using Phase changing material as a storage medium", Institute of Technology and Management (AIT&M) Belgaum, International Journal of Scientific & Engineering Research, December - 2012.

[3] Teltumbade, T., Walke, P.V.,"Experimental evaluation of single basin solar still using different absorbing material", International Journal of Engineering and Technology, 2011.

[4] Radwan, S.M., Hassanain, A.A, AbuZeid, M.A.,"Single slope solar still for sea water distillation," World Applied Science Journal, 2009.

[5] Mufag Suleiman K. Tarawneh, Jordon,"Effect of water depth on the performance evaluation of solar still", Journal of Mechanical and Industrial Engineering, 2007.

[6] Shukla S.K., Rai A.K,"Estimation of Solar Still output Under Indoor Environment", International Journal of Applied Engineering Research, 2010.

[7] Singh Ankur Kumar, RaiAjeet Kumar, SachanVivek, "Energy and Exergy Analysis of a Double Slope Solar Still", International Journal of Mechanical Engineering and Technology, 2014.

[8] Singh Parmendra, RaiAjeet Kumar, SachanVivek,"Study of Effect of Condensing Cover Materials on the Performance of a Solar Still", International Journal of Mechanical Engineering and Technology, 2014.

[9] "Experimental study of a single basin solar still with water cooling of the glass cover", RaiAjeet Kumar, Singh Nirish, SachanVivek, International Journal of Mechanical Engineering and Technology, 2013.

[10] HasanFalih M., Dr. Ajeet Kumar Rai, VivekSachan, Omar Mohammed,"Experimental Study of Double Slope Solar Still with Energy Storage Medium", International Journal of Advanced Research in Engineering and Technology 2014.

[11] A.A. El-Sebail, A.A. Al-Ghamdi, F.S. Al-Hazmi, Adel S. Faidah,"Thermal performance of a single basin solar still with PCM as s storage medium", Journal of Applied Energy, 2009.

[12] F.F. Tabrizi, Mohammad Dashtban, Hamid Moghaddam, "Effect of water flow rate on internal heat and mass transfer and daily productivity of a weir- type cascade solar still". Journal of Desalination 2010.

[13] Saravanan.M, Manikandan.K.,"Experimental analysis of Single Slope Stepped Solar Still with and without Latent Heat Thermal Energy Storage System (LHTESS)", Annamalai University, Annamalainagar, Tamil Nadu, India, International Journal of Research in Environmental Science and Technology 2012.

[14] M.Gowtham, M.SharathChander, K.V.SriSaila Mallikarujanan, N.Karthikeyan,"Concentrated Parabolic Solar Distiller with latent heat storage capacity", International Journal of Chemical Engineering and Applications June 2011.

[15] A. A. F. Al-Hamadani, S. K. Shukla,"Water Distillation Using Solar Energy System with Lauric Acid as Storage Medium", I.T. B.H.U, Varanasi, UP, India, International Journal of Energy Engineering 2011.

Srisakthi received his B.E. degree in Mechanical Engineering from Veltech Hightech Dr.Rangarajan Dr.Sakunthala Engineering College, Chennai, Tamilnadu, India, affiliated to Anna University Chennai in 2016. He is doing research work in Solar Desalination using PCM.

Bala kumar received his B.E. degree in Mechanical Engineering from Veltech Hightech Dr.Rangarajan Dr.Sakunthala Engineering College, Chennai, Tamilnadu, India, affiliated to Anna University, Chennai in 2016. He is doing research work in solar desalination using PCM.

Suyambu lingam received his B.E. degree in Mechanical Engineering from Veltech Hightech Dr.Rangarajan Dr.Sakunthala Engineering College, Chennai, Tamilnadu, India, affiliated to Anna University, Chennai in 2016 He is doing research work in Solar Desalination using PCM.