Renewable Energy Resources Report

Study on Various Solar Still

1. Introduction

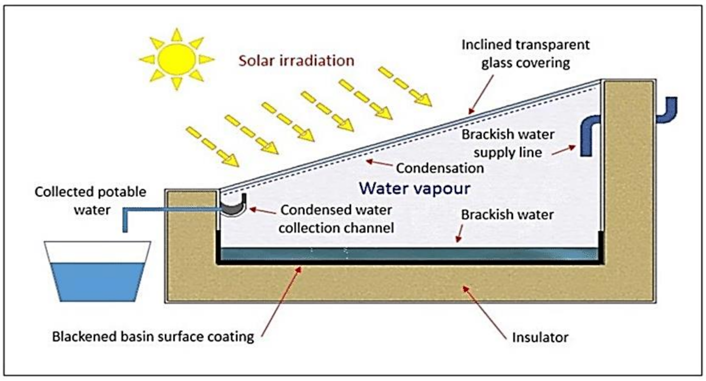
Solar energy can be used either for seawater desalination by producing the thermal energy required to drive the phase change processes or by generating the electricity required to drive the membrane processes. Solar desalination systems are classified into direct and indirect collection systems. As their name imply, direct-collection systems use solar-energy to produce distillate directly in the solar collector, whereas in indirect collection systems, two sub-systems are employed. Conventional desalination systems are similar to solar systems because the same type of equipment is applied. The prime difference is that in the former, either a conventional boiler is used to provide the required heat or mains electricity is used to provide the required electric power, whereas in the latter, solar energy is applied [1]. Many papers have addressed solar stills of various configurations, including . More specific studies include a hemispherical solar still , pyramid solar still , double-basin solar still , triple basin solar still.

2. Mechanism

The principle of pure water production from saline water using different designs of a solar water distillation technique is the same. The saline water in the trough mostly absorbs the solar radiation transmitting through the cover. The cover and the trough absorb the rest. Thus, the saline water is heated up to evaporates. The water vapour density of the humid air increases due to evaporation from the water surface. The water vapour condensed at the inner surface of the cover, releases its latent heat due to evaporation. Finally, the condensed water trickles down due to gravity and is stored in a collector

Passive Solar Still

A conventional solar still, which uses only solar energy to obtain a distillate output, is called a passive solar still. A solar still distils water with substances dissolved in it by using the heat of the Sun to evaporate water so that it may be cooled and collected, thereby purifying it. They are used in areas where drinking water is unavailable, so that clean water is obtained from dirty water or from plants by exposing them to sunlight.



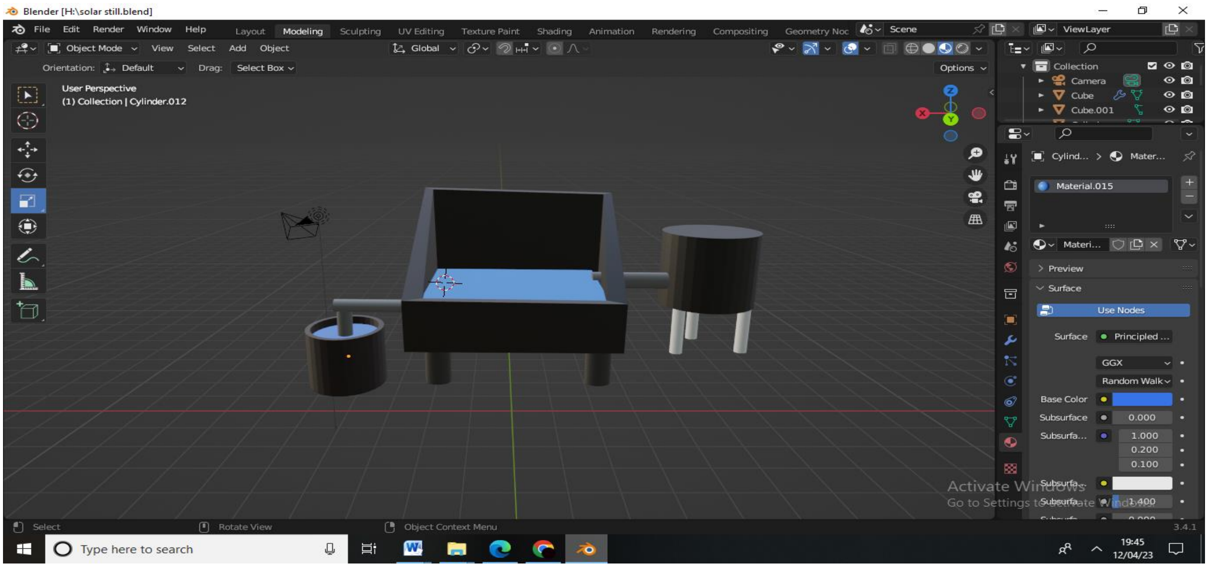
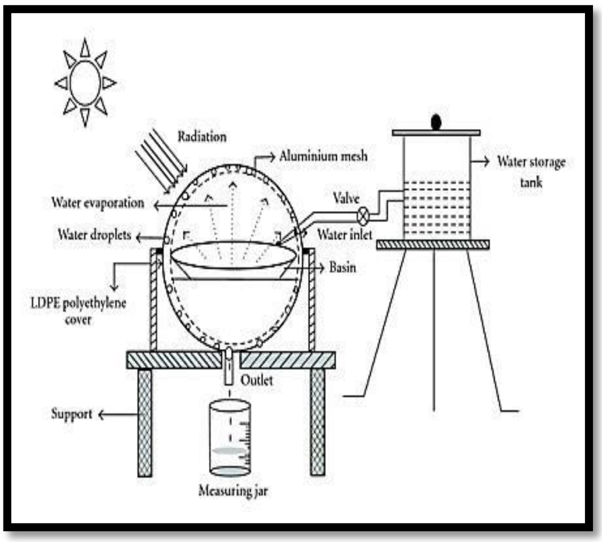


Figure shows the making of virtual solar still in blender

Spherical Solar still

A spherical solar still design with collector area of 0.28 m2 is presented. The still consists of a shallow circular basin of diameter



0.60 m that is made of steel. The circular absorber basin is coated with black paint for maximum absorption of incident solar radiation. The circular basin is fixed at the middle of the spherical aluminium mesh at radial height of 0.28 m. The saline water is stored in a basin with a capacity of 16 litres. The basin in the spherical solar still is fitted without having any physical contact with the top cover made of low-density polyethylene (LDPE) sheet. The LDPE sheet of thickness 0.107 mm is spread over the spherical mesh. A gap of 0.03 m is maintained between the circular basin and top cover. The evaporated water, which is condensed on the top cover, passes between this gap, and drips down towards the distilled water collection segment.

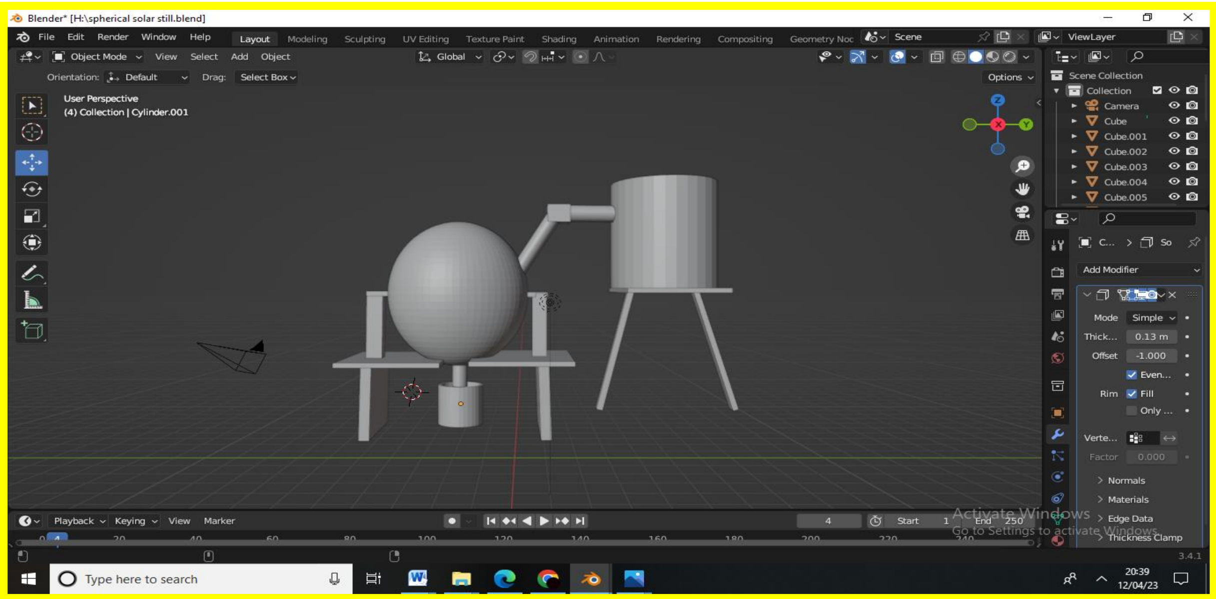
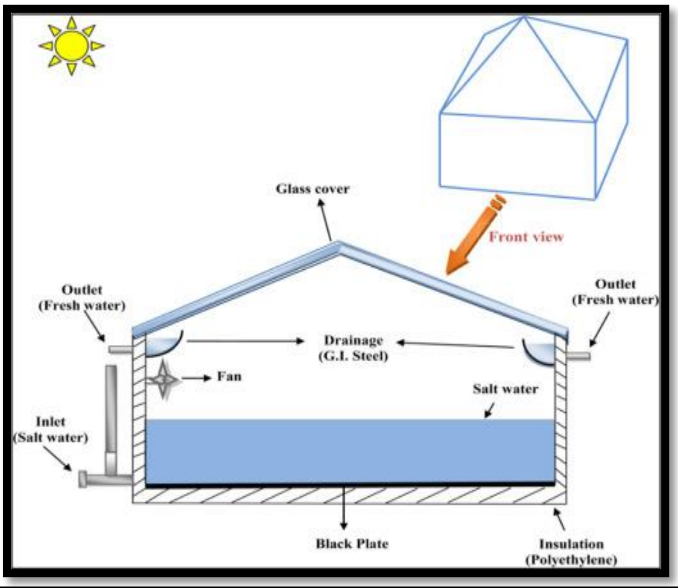


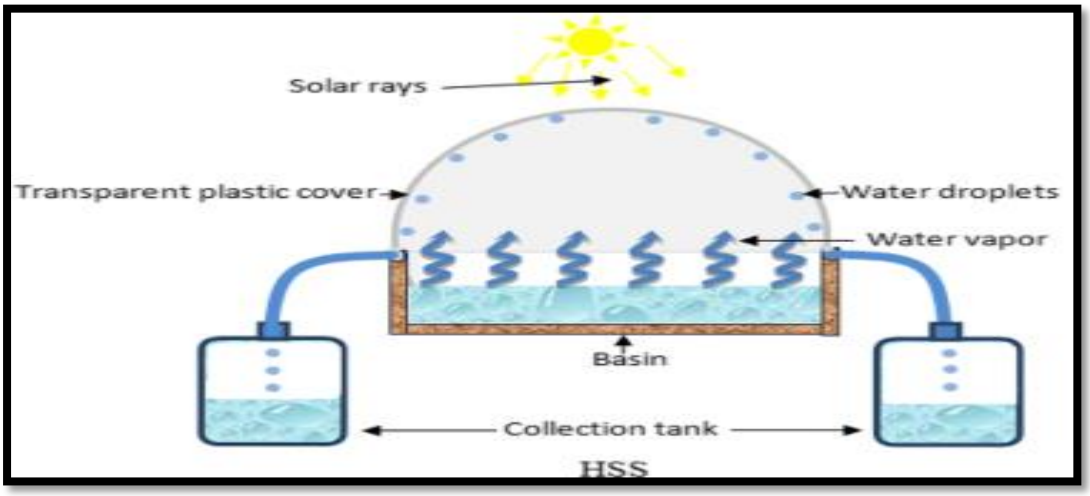
Figure shows the making of virtual spherical solar still in blender

Pyramid Solar Still



pyramid solar still is one in which top cover is in the shape of pyramid. There were mainly two shapes covers and basin available in pyramid solar still. triangular pyramid solar still and square pyramid solar still.

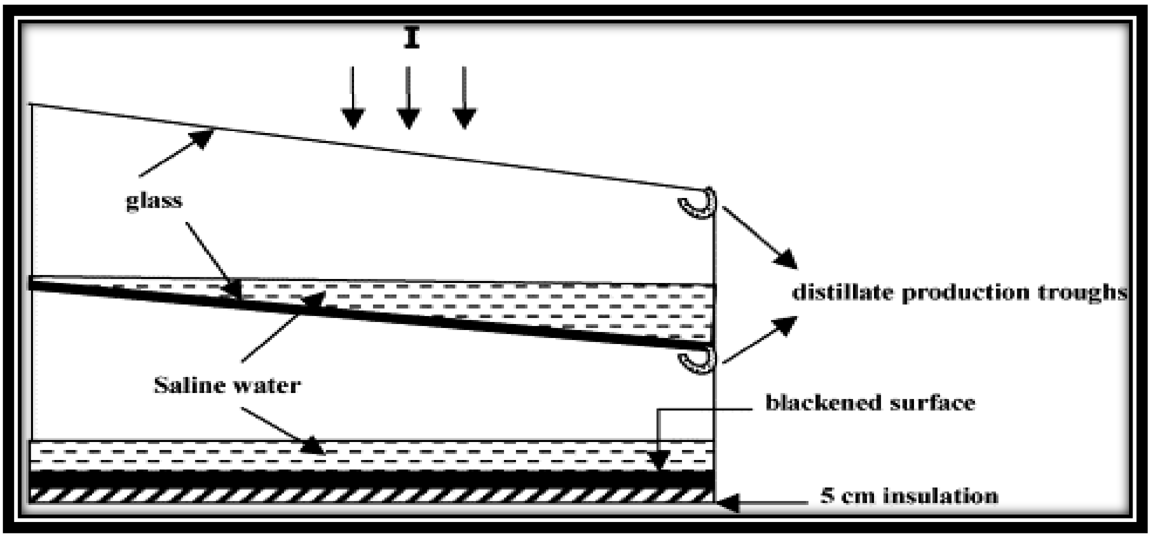
Hemispherical Solar Still



Hemispherical solar still is characterized by the hemispherical-shaped transparent top cover. The main purpose of using a hemispherical shaped top cover is to enhance the amount of solar energy that can be collected by the solar still.

Double Basin Solar Still

Solar still is one such method which makes use of naturally available sunlight to purify impure/saline water. A double-effect passive solar still is designed



to determine the freshwater collected at the output channel. The upper basin is partitioned into three segments to avoid the formation of dry spots on the higher portion of the inner glass cover. Silicon rubber sealant has been used to seal off and prevent the water leakage between the boxes of the still. A hole in the basin's sidewall allows saline or wastewater filling, as well as collecting the condensed water. Moreover, this is also used for inserting the thermocouple wires required for temperature measurements. When the still is in operation, the hole is closed with an insulating material to avoid heat and vapour losses.

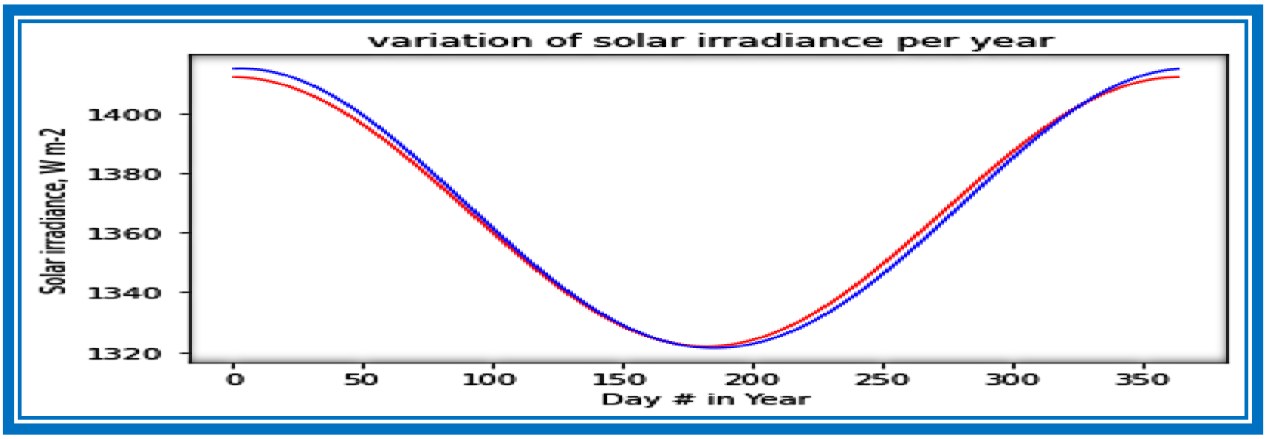
Variation of solar irradiance per year

The below code in yellow and graph shows the variation of solar irradiation per year using matplotlib.pyplot library in python software in anaconda jupyter notepad.

Gon – G for irradiance, o for outside , n for normal direction
Gsc – solar constant which is equal to 1367 W/m^2.

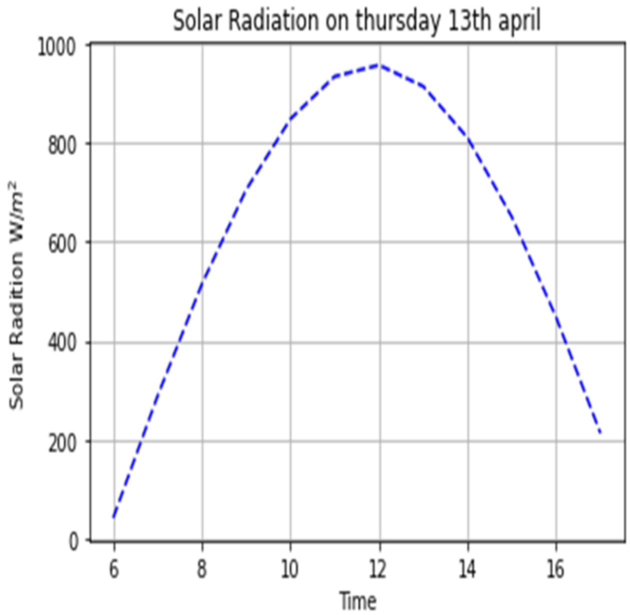
```
#from datetime import datetime,date,time,timedelta

import datetime

# import time

import math

#from geopy.geocoders import Nominatim

import matplotlib.pyplot as plt

import numpy as np

Gsc = 1367 #W m-2

n=int(input("enter any date in a year="))

def Gon(n):

 return Gsc*(1+0.033*np.cos(360*n/365*np.pi/180))

#print(Gon(10))

days=np.arange(1,365,1)

#print(days)
```

```
#print(Gon(days))

def B(n):

 return (n-1)*360/365*np.pi/180

def Gon_accurate(n):

 return
Gsc*(1.000110+0.034221*np.cos(B(n))+.001280*np.sin(B(n))+.000719*np..
cos(2*B(n))+.000077*np.sin(2*B(n)))

plt.plot(days, Gon(days),'r')

plt.plot(days, Gon_accurate(days),'b')

plt.xlabel('Day # in Year')

plt.ylabel('Solar irradiance, W m-2')

plt.title(' variation of solar irradiance per year')

plt.show()

#needed to display plot

#To get day in a year

today = datetime.datetime.now()

day_of_year = (datetime.datetime(today.year, 8, 6) -
datetime.datetime(today.year, 1, 1)).days + 1
```



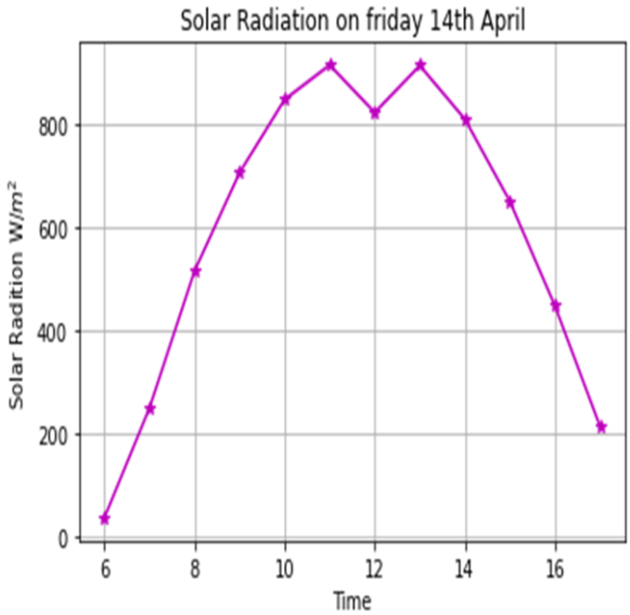
Variation of solar radiation per day in Python

```
import matplotlib.pyplot as plt

x=[6,7,8,9,10,11,12,13,14,15,16,17]

y=[42,288,514,705,848,934,957,914,810,650,447,213]

plt.plot(x,y,"b--")

plt.xlabel("Time")

plt.ylabel("Solar Radiation W/$m^2$")

plt.title("Solar Radiation on Thursday 13th April")

plt.grid()

plt.show()
```



The unit of measurement for solar radiation is expressed in W/m2 (Watts per square meter).

```
import matplotlib.pyplot as plt

x=[6,7,8,9,10,11,12,13,14,15,16,17]

y=[36,249,515,706,848,915,823,914,810,650,447,213]

plt.plot(x,y,"m*-")

plt.xlabel("Time")

plt.ylabel("Solar Radiation W/$m^2$")

plt.title("Solar Radiation on Friday 14th April")

plt.grid()

plt.show()
```



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