Solar Still

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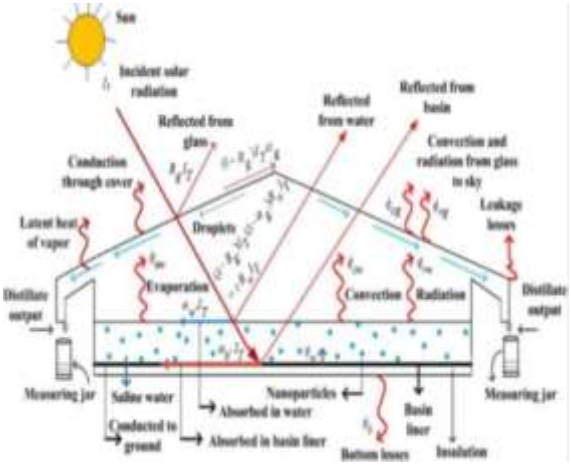
***Abstract*- Water is the main source for sustaining living beings on earth. Water shortage has become one of the major global challenges, which is linked to population growth. Ground water and reservoirs are the available sources of fresh water. But these sources are not always useful due to pollution and dissolved impurities. Solar distillation is a process by which we can purify the salty, blackish water with the help of solar radiation. The main goal of this paper is to provide drinking water from salty, blackish water.**

Index Terms- Solar Water Distillation, Solar Energy, Active Techniques, Solar Still, Performance etc.

1. INTRODUCTION

Water is an essential element on earth for the living beings. Nearly three fourths of earth surface is covered with water and 97% of which is salt water in the oceans. On the other hand remaining water is in the form of ice, ground water, lakes and rivers. Only less than 1% of the available water is fresh and accessible to humans. Water on earth is contaminated with impurities and chemical substances. Therefore it cannot be used for agriculture, industrial and human consumption.

Demand for clean uncontaminated water is an integral part of daily life. Healthy drinking water is unavailable in impoverished region is increasing day by day parallel to increasing population on earth. Distillation is thermal energy based process that removes impurities from water. Solar distillation is one of the methods of getting distilled water using solar energy. Due to abundant solar energy solar distillation is cost saving in comparison to other types of distillation such as reverse osmosis. Now day's solar stills are widely used for distillation. It is one of the most important and technical application of solar energy. It is an inexpensive device.



2. BASIC PRINCIPLE OF SOLAR STILL

A solar still is a device used to produce clean, drinkable water from dirty water using solar energy from the sun. It is coupled with thermal collectors, concentrators, and photovoltaic panels which makes the system active and increases distillation three to six times. The sun energy heat water to the point of evaporation. When water evaporates, water vapour rises, which condenses on the glass surface and they are collected by using collectors. This process removes impurities and eliminates micro organisms.

3. PARTS OF THE SOLAR STILL

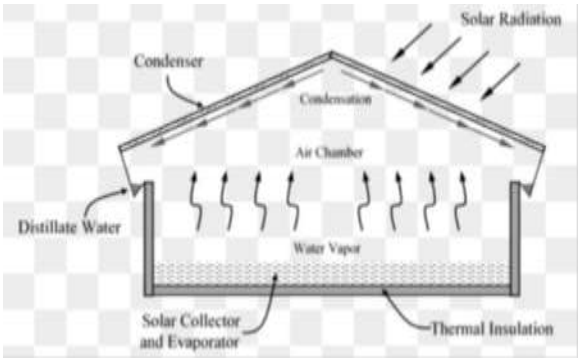
The major parts of a solar still are given below.

A.Transparentcover- It should have high transmittance for solar radiation, opaque to thermal radiation, low cost, light weight, easy to handle and long life. This cover transfer solar radiation into the still and also helps to condensate the vapour. The material uses for transparent cover is glass.

B. Black liner-It should be durable, easily cleanable, water tight, low cost and should be able to tolerate

temperature around 100 degrees Celsius. It is used to absorb solar radiation in thebasin of the solar still.

C. Basin tray- The water is initially stored in the basin tray of the solar still. The materials used for basins should have long life, high resistance to corrosion and low cost. The commonly used materials are steel, galvanized iron, wood, aluminium, asbestos cement, concrete etc.



D. Sealant-It is used to prevent the vapour leakages through the sides of the transparent cover in the solar still. Materials used as sealant are putty, tars, tapes silicon etc.

E. Insulation-The solar still is thermally insulated to prevent the heat loss through the side walls and the basin. Vapour leakage is prevented by sealant. The energy received from the sun should be kept inside the still to vaporize water. The materials used are saw dust, glass wool etc.

F. Condensate channel-The vapours which are generated inside the solar still is condensed on the inner surface of the transparent cover and water droplets move down words. The fresh water is collected through the condensate channel fitted inside the solar still. The materials used for the condensate channel are galvanized iron, aluminum, plastic materials etc.

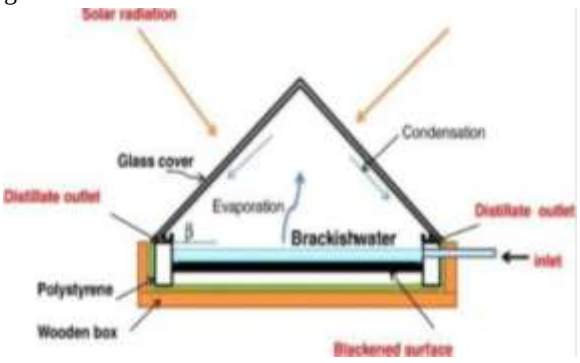
G. Water supply system- Salty water should be supplied into the still continuously depends on the type of still likely in noctournal production stills water is fed once a day,in wick type systems the feed rate of water should be kept equal to the evaporation rate of water from the still. The water supply system includes overhead tank, pipes to carry water into the still and regulatory valves.

4. TYPES OF SOLAR STILL

According to the type of input energy, the solar stills are classified into passive solar still and active solar still.

A. Passive solar still-It uses solar energy for distillation purpose. It gives lower productivity in comparison with active distillation system. In present days, most of the solar stills are working on passive distillation system because they need sunshine to operate it. The solar radiation is received directly by the solar still and is the only source of energy for rising the water temperature and thus the evaporation of water which condenses on the glass surface leads to lower productivity of pure water. The solar still used for passive distillation system is basically a sealed enclosure, containing impure water. The impure water is heated by absorption of solar radiation. This causes the transport of water vapour from the impure water to the top transparent glass cover and from there it condenses into the distillate chamber.

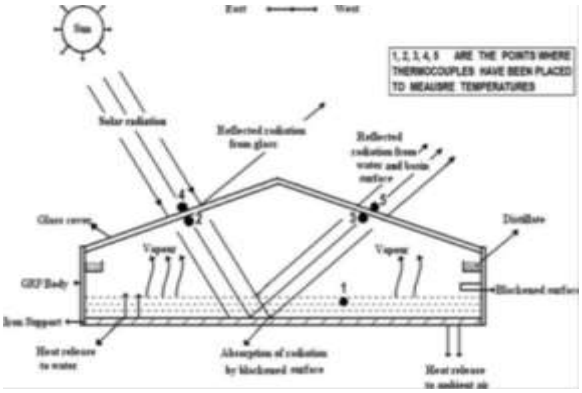
The parameters which are affecting the solar still are water depth in the basin, material of the basin, wind velocity, solar radiation, inclination angle of the glass cover and ambient temperature. The yield from the solar still is proportional to the temperature difference of water in solar still and inside of the glass cover.



Experimental observations made on 12 April 2018 by passive solar still.

Time (hrs)	Water temperature (°C)	Still output (ML)
11:00 AM	40.1	96
12:00 AM	61.0	160
01:00 AM	65.6	120
02:00AM	68.1	200
03:00 AM	63.5	220

B. Active solar still- It is an efficient technique to fulfill the need of potable water for a family using renewable energy. It uses external sources of energy to power blowers, pumps and other types of equipment to collect, store and convert solar energy. These external sources supply thermal energy to the basin water along with the direct sun rays. It uses pumps or fans to circulate fluid through solar collectors. It combines with external sources such as flat plate collector, photo voltaic panels, evacuated tube collector, heat pipe and hybrid system which improves the daily distillation productivity and makes the solar still active. The solar collectors use liquid or air as conductors to store and convert energy. Those that use liquid are known as hydraulic collectors, while those that contain air are called air collectors. Liquid conductors are more common than those that are air-based, as liquid is generally more efficient at conducting heat; while air based solar systems have the benefit of non-freezing.



Experimental observations made on 22 April 2018 by active solar still.

Time (hrs)	Water temperature (°C)	Still output (ML)
11:00 AM	41.1	130
12:00 AM	63.0	182
01:00 AM	70.6	420
02:00AM	74.1	450
03:00 AM	62.5	320

5. RESULT OF SOLAR STILL

The production of distilled water depends on the solar radiation and on the level of water in the tank. When the radiation increases production also increases. There is an inverse relationship between solar radiation and water level in the tank. The daily output of solar still depends upon the ratio of water vaporization energy and latentheat of vaporization.

The solar still output is given by: -

$MOUT = \eta OVERALL \times G \times A / \Delta hv$

$\eta OVERALL$ = Overall Efficiency of Solar still

Δhv = Enthalpy of vaporization

A=Area of basin

MOUT =Water output

ASSUMPTIONS

A. Glass cover inclination is small.
B. The condensation that occurs through the glass is film type.
C. The solar still is vapour leakage proof.
D. Irradiation of sun can take a longer production time.
E. Water level in the basin is maintained at a constant level.
F. The absorbing heat capacity of the glass cover is negligible.

6. CONCLUSION

Water and energy are the basic necessity for all of us to lead a normal life on earth. Solar energy is abundant and limit less, free of cost and environmental friendly. The technology based on solar energy and its usage is very important and useful for developing and underdeveloped countries, to sustain their energy needs. Use of solar energy in distillation process is one of the best applications of renewable energy in daily life. Solar still is good for operation, maintenance, repair and are user friendly to the human beings in nature. This paper investigates the optimization of different parameters of distillation process. According to this maximum output is possible in the month of April and May.

7. ACKNOWLEDGEMENT

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