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RESEARCH ARTICLE

WATER DISTILLATION BY SINGLE SLOPE SOLAR STILL

Suresh N[1*]., JayaPrakash R[2]. and Dhanabagyam S.[3]

[1]SVS college of Engineering, Coimbatore.
[2]Sri Ramakrishna mission vidyalaya college of Arts and science. Coimbatore
[3]Bharathiar University, Coimbatore

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ABSTRACT:

The aim of this work is to frame a water purification system that can purify water by using a distillation system, and this system is cheap, portable and depends on renewable energy source. Distillation is one of the process of water purification by the resource of heat, electricity or solar radiation. By using the solar energy in this project for purification of water it is called solar distillation process or system. The main use of solar energy is to increase the quality and purification of drinking water in rural areas.

INTRODUCTION: Solar distillation is a tried and true technology. The first known use of stills dates back to 1551 when it was used by Arab alchemists. Other scientists and naturalists used stills over the coming centuries including Della Porta (1589), Lavoisier (1862), and Mauchot (1869). Solar still is a device to desalinate impure water like brackish or saline water. It a simple device to get potable/fresh distilled water from impure water, using solar energy as fuel, for its various applications in domestic, industrial and academic sectors.

A solar still consist of shallow triangular basin made up of Fiber Reinforced Plastic (FRP). Bottom of the basin is painted black so as to absorb solar heat effectively. Top of the basin is covered with transparent glass tilt fitted so that maximum solar radiation can be transmitted in to the still. Ages of the glass are sealed with the basin using tar tape so that the entire basin becomes air tight. Entire assembly is placed on a structure made of MS angle.

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Corresponding author:
Suresh N.
SVS college of Engineering, Coimbatore

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Out let is connected with a storage container. Provision has been made to fill water in the still basin. A window is provided in the basin to clean the basin from inside. Water is charged in to the basin in a thin layer.

Solar Stills have got major advantages over other conventional Distillation / water purification /de-mineralisation systems as follows :

1. Produces pure water
2. No prime movers required
3. No conventional energy required
4. No skilled operator required
5. Local manufacturing/repairing
6. Low investment
7. Can purify highly saline water (even sea water)

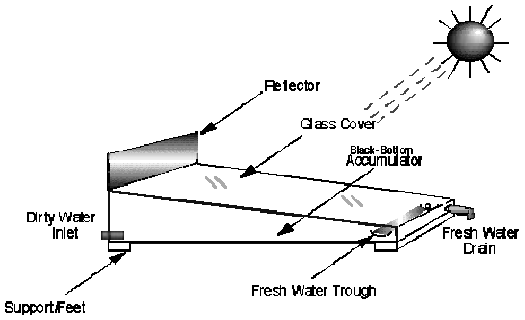
Solar stills is an useful devise to get fresh/ distilled water which is required in The first "conventional" solar still plant was built in 1872 by the Swedish engineer Charles Wilson in the mining community

Industries	for industrial processes
Hospitals and Dispensaries	for sterilization
Garages and Automobile Workshop	for radiator and battery maintenance
Telephone Exchange	for battery maintenance
Laboratory Use	for analytic work
Marshy and costal area	To get fresh potable water

of Las Salinas in what is now northern Chile (Region II). This still was a large basin-type still used for supplying fresh water using brackish feed water to a nitrate mining community. The plant used wooden bays which had blackened bottoms using logwood dye and alum. The total area of the distillation plant was 4,700 square meters. On a typical summer day this plant produced 4.9 kg of distilled water per square meter of still surface, or more than 23,000 liters per day. This first stills plant was in operation for 40 years!

Over the past century, literally hundreds of solar still plants and thousands of individual stills have been built around the world. SolAqua stills have built upon years of still research and development, use NSF and FDA approved materials, and are the state of the art for commercial solar still distillation. The basic principles of solar water distillation are simple yet effective, as distillation replicates the way nature makes rain. The sun's energy heats water to the point of evaporation. Solar stills use natural evaporation and condensation, which is the rainwater harvesting process. This permit for natural pH buffering that produces super taste as compared to steam distillation. Solar stills can be easily providing enough water for family drinking and cooking needs. Solar distillers can be used to effectively remove many impurities ranging from salts to microorganisms and are even used to make drinking water from seawater. As the water evaporates, water vapor rises, condensing on the glass surface for collection. This process removes impurities such as salts and heavy metals as well as eliminates microbiological organisms. The end result is water cleaner than the purest rainwater. The solar still is a passive solar distiller that only needs sunshine to operate. There are no moving parts to wear out. Solar stills have been well received by many users, both rural and urban, from around the globe. solar distillers can be successfully used anywhere the sun shines.

Still Operation: A solar still operates on the same principle as rainwater: evaporation and condensation. The water from the oceans evaporates, only to cool, condense, and return to earth as rain. When the water evaporates, it removes only pure water and leaves all contaminants behind. Solar stills mimic this natural process.



This interior surface uses a blackened material to improve absorption of the sun's rays. The heated water vapor evaporates from the basin and condenses on the inside of the glass cover. In this process, the salts and microbes that were in the original water are left behind. Condensed water trickles down the inclined glass cover to an interior collection trough and out to a storage bottle. The still is filled each morning or evening, and the total water production for the day is collected at that time. The still will continue to produce distillate after sundown until the water temperature cools down. Feed water should be added each day that roughly exceeds the distillate production to provide proper flushing of the basin water and to clean out excess salts left behind during the evaporation process. The intensity of solar energy falling on the still is the single most important parameter affecting production. The daily distilled water output (M e in kg/m2 day) is the amount of energy utilized in vaporizing water in the still (Q e in J/m2 day) over the latent heat of vaporization of water (L in J/kg).

Solar still efficiency (n) is the amount of energy utilized in vaporizing water in the still over the amount of incident solar energy on the still (Q t in J/m2 day). These can be expressed as:

Solar still production: $M_e = Q_e / L$
Solar still efficiency: $n = Q_e / Q_t$

Typical efficiencies for single basin solar stills approach 60 percent. General operation is simple and requires facing the still towards solar noon, putting water in the still every morning to fill and flush the basin, and recovering distillate from the collection reservoir (for example, glass bottles). Stills are modular and for greater water production

requirements, several stills can be connected together in series and parallel as desired.

As water evaporates from the solar still basin, salts and other contaminants are left behind. Over time, these salts can build to the point of saturation if the still is not properly maintained and flushed on a regular basis. Properly operating a still requires about three times as much make-up water as the distillate produced each day. If the still produced 3 gallons of water, 9 gallons of make-up water should be added, of which 6 gallons leaves the still as excess. The excess water flushes the still basin through the overflow to prevent salt buildup. If this is done on a daily basis, the flushed water is of approximately the same quality as the original feed water that was added to the still. The excess water is of suitable quality that it can be used to water landscaping, wash pots and pans, etc. No sediment or sludge will buildup if the still is properly operated and flushed daily.

Still Water Production: Solar still production is a function of solar energy (insolation) and ambient temperature. A solar still produces about 0.8 liters of purified water per sun-hour (i.e. 1 kWh). Thus, can have average about 3 liters per day in the winter (4 kWh/m2/day) to over 6 liters per day during the summer (8 kWh/m2/day)

Distillation Purification Capabilities: Solar stills have proven to be highly effective in cleaning up water supplies to provide safe drinking water. The effectiveness of distillation for producing safe drinking water is well established and recognized. Most commercial stills and water purification systems require electrical or other fossil-fueled power sources. Solar distillation technology produces the same safe quality drinking water as other distillation technologies; only the energy source is different: the sun.

Solar distillation removes all salts as well as biological contaminants. There are many studies in the literature, such as tests conducted on solar stills at New Mexico State University and Sandia National Laboratories, which clearly verify solar stills' effectiveness in eliminating microbial contamination and salts.

CONCLUSION : Distillation of water using solar still basin is the most economical method to get portable drink water. The water that is made in these stills is of a better quality than bottled water because it is purified using the distillation process, and because the water is slowly evaporated instead of rapidly boiled, the water tastes sweeter due to the natural process. Contaminants such as salts, odor, heavy metals, bacteria, micro-organisms, sand, rust, fluoride etc. are completely removed in the distillation process. A theoretical work is constructed to predict the performance and productivity of active single slope solar still using different operational parameters. The ambient conditions (i.e. Time and solar intensity) are considered to have an effect on the overall still productivity. It has been established that the overall system efficiency in terms of daily distillate output will increase by increasing the basin water temperature and the use of latent heat of condensation for further distillation.

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