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A DETAILED REVIEW ON SOLAR WATER DISTILLATION SYSTEM

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Abstract: The life on earth cannot imagined without the water .The ocean covers about 71% of total water on the Earth .Only 1% of water are available for the livings .Potable or fresh water (water having less than 500ppm salt content) is one of the fundamental necessities of life for human .Factories and all the primary (agriculture activities) sectors require pure water for the production. Many countries are facing potable or fresh water shortage. From the beginning, mankind is dependent on the small water source like ponds, lakes, rivers, underground water reservoirs to fulfill the basic needs. Nowadays Per capita consumption of water increased due to modernization. The demand of fresh water also increased due to urbanization, industrialization and mainly population explosion. Most of the fatal diseases are spread due to consumption of impure water. Not in India but also in many countries facing the scarcity of fresh or potable water because of unwanted activities and the waste produced by humans and exposed in the nature. At this time water purification without disturbing the nature is necessary. Many conventional and non conventional techniques have been introduced for the purification of salty and impure water. Solar energy is the clean energy easily available everywhere which can be utilized for the purification of water. The best way for the purification of water is solar distillation which is very economical and eco friendly. It can be easily used in rural as well as urban areas. This article provides a detailed review of different studies on solar water distillation system in India. Solar water distillation is the method of using energy from the sunlight to separate freshwater from salt or another contaminants (salt content) and makes the water suitable for drinking .Solar still makes water free from TDS (total dissolve solid).The distillation of salt or impure water to recover potable water is accomplished by exposing thin layers of the salt water to solar radiation ,and condensing the vapour produced on the transparent cover in such a way that it can be collecting in receiving troughs. The effective way to remove the impurities of the water (salts, microbes) is solar distillation and can be used to make drinking water from seawater. Solar stills are highly effective for purification of water and can be used everywhere where the Sun reaches

Keywords: Distillation, Contaminants, Scarcity, Distillers, impurities, TDS, potable

1 Introduction

Natural resources are gifted to the livings by the nature without any demand. Water is one of them. It plays the main role in development of the Nation. Approximately 97% of water on the Earth is not suitable for drinking that is present in ocean; only 1% is good for drinking.[1]

In the recent survey 80% of all illness and death of the living world are due to the potable water scarcity. Maximum health issues are due to the unhealthy water .Water having less than 300ppm is best for drinking. Nowadays, the Earth receive insufficient amount of water in rainfall due to the deforestation and many human activities which makes the water impure .The discharge of industrial waste ,household and other biological or non biological waste directly in the available water source makes them polluted.[2]

Today a huge population is not getting pure water for drink .They even drink the impure water. In some places people travel 30 km to collect fresh water. Majority of rural people are still unaware of the consequences of drinking untreated water. According to an estimate 79 % of water are salty 20% are brackish (water from wells) and only 1% is available for as fresh. The purification of impure water by the use of solar energy is first introduced by LAS SALINAS, in Chile.[3]

The conversion device is called solar still. Nowadays several types of solar stills are developed and commercialized. By the day there are many techniques are introduced in the solar still that increases its efficiency and also developed in many aspects. [4]

The distillation of water takes places in four different phases in nature as follows:

a) The evaporation of water sources
b) The raising of vapour to the upper part where the cooling of humid air done with the help of convective winds.
c) The condensation of this vapour by in the form of rain
d) After the raining the water returns to the ocean
The rain water is in the purest form due to solar distillation naturally.

2. LITERATURE REVIEW

Many researchers have experimented on solar distillation several of them modify the solar still and introduced the new techniques in the distillation system.

Prof. Alpesh Mehta has done the research on solar still and found that maximum output in the afternoon (11am to 1pm), he also noticed that the output only 10% of the inlet water. Which means that 2 litre of pure water is obtain by 20 liter of impure water. The PH level of pure water is 7, which is suitable for the drinking.[5]

The scientists of IIT Guwahati have already researched on solar water distillation. They mainly focuses on modification of solar still by which they can be obtain maximum output. They focused on dissimilar parameters such as solar intensity, wind velocity, ambient temperature, water-glass temperature difference, free surface area of water, absorber plate area, temperature of inlet water, glass angle and depth of water, on the working and performance of solar distillation units. [6]

Prof. S.L yadav and others have researched on the modification of solar still in Aurangabad .They compare four different stills of different capacities. They noticed that the maximum productivity of the solar stills is in afternoon between 11am to 2 pm .The outlets obtained by this process has high purity .The pH level of the water is 7 .The water obtained by this process is salt free [7]

Amitava Bhattacharyya has done the research on solar water distillation by making the solar stills fabricated. He also use the capillary tubes in his experiment. The capillarity tubes traps the thermal energy which increases the rate of evaporation. In this process the output increases. He mainly focused on the use of fabricated capillarity still which facilitates high evaporation of water at minimum heating and cost effective manner. [8]

In California state science fair the research was done by Jaime E. Wood .In his research he noticed the effects of Fresnel lens upon solar stills. This setup increases output of the purification. In his experiment he takes the reading in every 120 minutes. He observes that the productivity is increased as compared with other stills. The average test produces 47.1 grams of water as compared to 32.6 grams of water during 120 minutes. The Fresnel lens increases its efficiency by 44%. [9]

In University of St. La Salle, Bacolod city the research was done on solar still developments [10]. The Fresnel lens was made of acrylic plastic that is very good reflector of solar radiation .The Fresnel lens concentrate all the rays at a point in the tray which is already dark. The energy was transferred from glass to water mass. At the basin solar rays are absorbed and emitted as thermal radiation based on its absorptive and emissivity. The solar flux is reflected back to surrounding from glass cover and water basin .The water vapour get condensed at the top and collected and separated

A group of professors in jaipur have done a research on Solar Water Distillation system. They mainly focused on the all geometric aspects of the distillers. They introduced the solar radiation concentrator in the system. This gives the extra energy to the system that maximizes the evaporation and decreases the heat losses .The solar energy coming from the sun are concentrate to the water intake pipes that causes the pre heating of impure water before feeding inside the basin of the solar stills. This may leads to the great amount of hike in the efficiency of solar still. [11]

A research on solar water distillation is done by a team of professors in Hyderabad. They mainly focused on the mechanics of thermal energy on solar distillation. They utilized the latent energy or thermal energy for maximizing the evaporation without losses. They improve the solar still by nonmaterial, sponges, dyes etc [12]

Finally, many researchers have also studied different parameters influencing the performance of solar stills. Few of them also focused on thermodynamics analysis such as energy balance and losses by using Second Law of Thermodynamics and reported in their literature.

3. MATERIAL USED

3. 1. Building prototype still

The still is the basic device used for solar distillation. Before choosing the materials of still the performances of material should be evaluated. The installation of stills depends upon many factors such as solar radiation, angle of inclination sun rays, basin area, latitude etc. Generally double slope stills are used because of its better performance. A simple still require plastic films or transparent glass, wood, black basin etc.

The properties of the materials should be favorable for the still working. The basin type solar still is shown below:

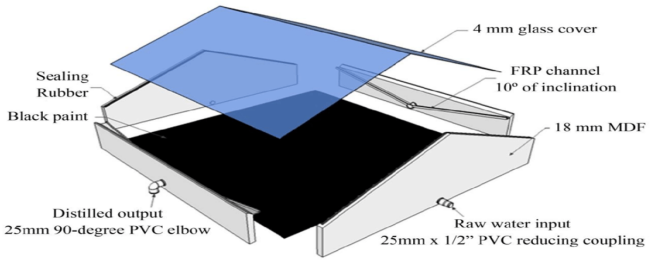

Figure 1 Basin type solar still

Once, the Still Materials are ready. Firstly, it should be noticed that the basin material should have high absorptive, low reflexive and less conductive. Stainless still and aluminum should be preferred for the still basin because they fulfill the requirements of the still condition.[13]

Secondly for the selection of insulating materials of still, the materials should be of low conductivity and the availability of material is easy.

Other important still material is the glazing cover, it is located of top to still, where the steam is condensate and a little clean water drops are produced and then it is collected in troughs. There is much information about glazing cover and it´s common to use polyethylene, acrylic and tempered glass, however, these materials are expensive and they can´t get in local areas.[14]

Once, the still is ready then mechanical work should be done very carefully for example: holes in basin, hydraulic leaks in pipeline and wind infiltrations.

All the materials that are used for the making of still should be easily available in the locality.

4. METHOD OF SOLAR WATER DISTILLATION

TYPES OF SOLAR WATER DISTILLERS

There are mainly two type of Solar Water Distillation

a) Passive Distillation
b) Active Distillation

The only solar energy is directly used for the evaporation of water in passive distillation. So the performance of passive still is low, whereas an additional thermal energy is given in active type of solar distillation. The heating of water is done inside the still only in passive still. Hence the efficiency of active solar distillation is greater than that of passive distillation. Many attempts have been taken to improve the efficiency and productivity of solar stills i.e., hot water is introduced in the basin that increases the rate of evaporation. All the advancement is done in the Active type of distillation.[15]

The classification of solar distillation is as follows:

The Passive e and Active solar stills are further classified in many ways .The Active distillation is more efficient than that of active distillation because of extra fabrication.

The different parameters that concern the efficiency of solar water stills:

In this method have depth of water in sink, airstream, solar emission, ambient temperature and the angle of inclination. The output of any kind of still is directly depends on the temperature variation among the water in the sink and internal exterior glass face [16].

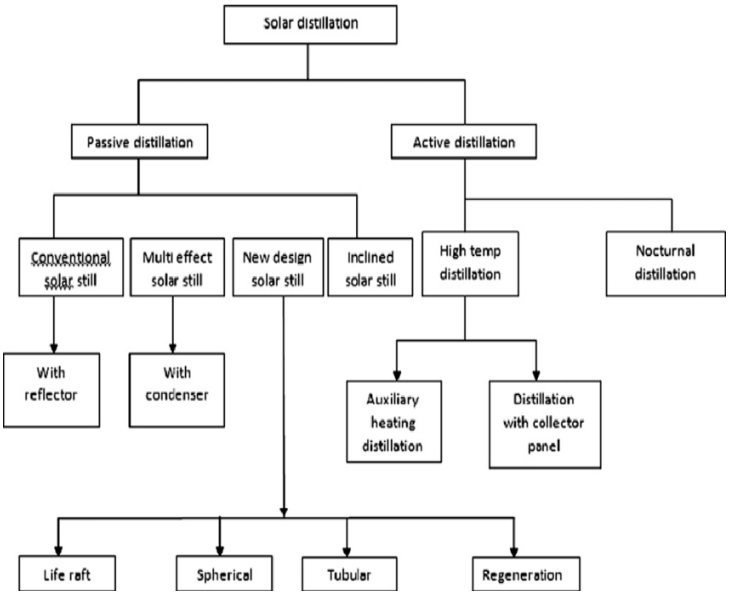

Figure2. Flow chart of solar still

4.1 PASSIVE DISTILLATION

In Passive solar stills the sun rays is directly conventional by the sink of still and it is the just resource of evaporation of water. This leads to the less productivity as compared to Active still. There is no any preheating of water is done before putting in the still [17].

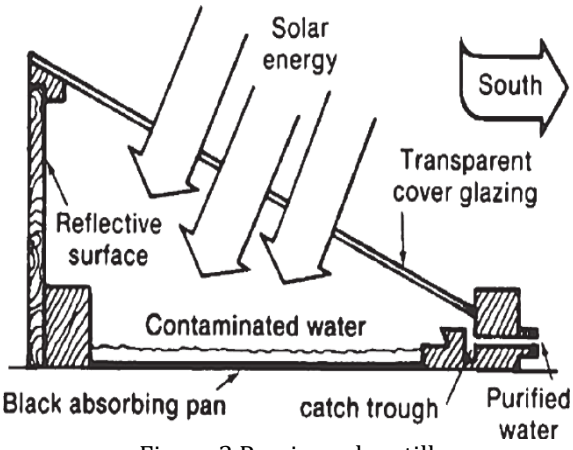

Figure 3 Passive solar still

4.2 ACTIVE SOLAR STILL

Active type of Solar still is the modified form of Passive solar still in which an extra thermal energy is supplied to the water in the basin through the outside form to increases its productivity. In present time numerous type of Active solar still depends upon modification [18].

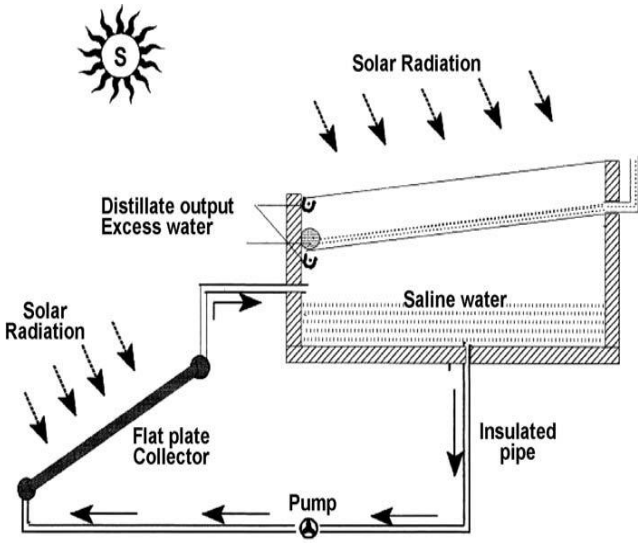

Figure 3. Active type solar still

4.3 REGENERATIVE SOLAR STILL COUPLED WITH PARABOLIC CONCENTRATOR

Regenerative solar still is attached through parabolic concentrator as shown in figure below. In this fluid water above the glass is prepared to decrease tumbler hotness of the solar still. Heat is transferred to the flowing water from the glass which makes great temperature dissimilarity. This regenerative type solar still increases its productivity. The inlet water gets preheated before entering inside the solar still [19].

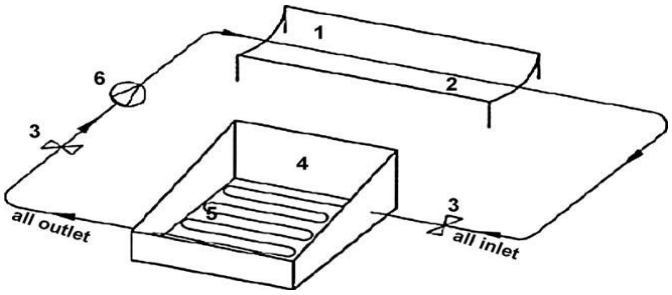

Figure 4. Solar still with parabolic collector [26]

5. Research and Pilot Schemes in India

5.1 National Institute of Ocean Technology (NIOT)

The Ministry of New and Renewable Energy Department that have working the various project that are only depend upon the renewable energy. This is combined operation with ocean technology to purification of ocean water in portable water. This is work on low temperature thermal desalination process. This technology deals the temperature variation in different level of sea. The heated water get evaporated and the vapors are collected on the surface of solar water distillation. After sometimes the vapors are collected into the purified water [20].

5.2 Department of Science & Technology (DST)

In India water distillation project s are installed in Coimbatore. The Karnataka State Governments provides subsidy to install the water still .According to this methodology, firstly we have use the sun radiation to convert in the form of thermal energy and this energy is use for the heating of water present in basin. Researchers have designed the linear Fresnel reflector system that distilled the saline water in the form of purity (TDS free) [21].

5.3 Gerindtec

In recent times, the Government of India is working with two major projects which is based on patented technologies called **Multi Effect Humidification (MEH)** process. In this method we have use the sun radiation to heat the impure water and then heated water is transfer into the container. In second process we have condensed the water vapour in the form of water droplet that is collected in the external pot [22]

5.4. BARC

In India BHABHA ATOMIC RESEARCH CENTRE has developed the technology to purify the water by using the solar and wind energy to distillation of water. Under this technology BARC removes the hazards elements like turbidity and pathogens. They are also used to remove the impurity of water by electricity as well as osmosis process [23]

5.5 Developing Indigenous Resources (DIR)

The Punjab government started to purify the water by still. It has small scale process to distill the water. The main purpose of whole project to manage the water distills because we have obtained the best quality of water for living people [24].

6. CONCLUSION

The solar still are very helpful in rural areas where the availability of pure water is less. The Solar still are easy to handle and operate and can be implemented anywhere where sun radiation is available.We can also increase its efficiency by introducing the new techniques such as the water which is used for the purification should be primarily treated before introducing inside the solar stills.

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