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EXPERIMENTAL INVESTIGATIONS ON A SINGLE SLOPE SOLAR STILL

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Abstract - *The objective of this study is exploring the use of solar energy as a source for producing usable water from water of local source. The conversion of raw water to purify water has been done by a double slope solar still system. This system is designed with the aspects of cost, handling, maintenance and its effectiveness. The purpose of solar still system designing and its fabrication is very simple to avail water free from impurities .In India impure water resources are available everywhere ,to make it useful a high energy potential is required. Potable water is the biggest problem in the coastal areas where salty water is abundant. To remove impurities and making water usable for drinking, this can be done by natural phenomenon of evaporation and condensation. The continuous evaporation and condensation process is distillation which is very common process for water purifications. Any water purification plant is operated with energy input. The present study is based on single slope solar still construction and its operating under tropical zone of continent as India. Geographical allocation of setup in Agra U.P. defined as 27.1767^{o} N latitude and 78.0081^{o} E longitude and summer weather season May-June.*

***Key Words*: Single Slope Solar Still, Solar Energy, Active techniques, etc.**

1. INTRODUCTION

In India Contaminated water is a major problem, generally contamination typically categories as air, water, sound etc. When we consider a good human life impure water is a big challenge for our society. The water may be contaminated by different agents like chemical, biological, some other things like garbage's. The present study is focused on this aspect of water purification or removal of contaminants. This way technological involvement may be move for production of water which is well suited to human health and environment's far as industries based on potable water , their need of suitable water as a raw material can be meet out by conversion of pollutant water to usable water.

1.1 ALTERNATES FOR WATER PURIFICATION

There are mainly four types of considerable way for water purification:-

1. Distillation of contaminated water
2. Mechanical Filtration by cotton or mesh
3. Chemical Treatment by bacteria killing agents
4. Irradiative Treatment

2. WORKING PRINCIPLE

The operation of the still is very simple. The incident solar radiation is passes through the sloped transparent and reaches to base of still basin which is filled with water, that is heated with the solar heat incident on it, so water get evaporate and reaches to glass surface but due to temperature difference it condense on this surface of glass layer and flows down along the sloped glass cover to the channels, where it can be storage in a distillation vessel or tank.

Solar working principle is based on regular evaporation and condensation, a constant level of water is maintained and radiation is trapped in a insulated box, these radiation has form of heat energy. The heat energy is responsible for evaporation phenomenon. The rate of evaporation can be accelerated by increasing the absorption of solar heat .Solar absorption can by employing more absorptive capacities material as in this study black coated aluminium sheet, Coal powder, joot cloth and concrete material are used.

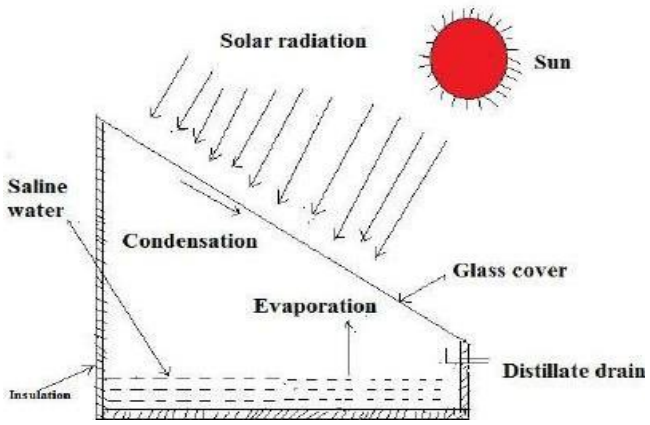


Figure-1 Basic Principle of Solar Still

Still has different absorptive materials to check absorption of solar radiation, including this a constant head , level of brackish water is maintained so that effective convection can be obtained for this separate arrangement has also is incorporated to supply water inside the still, The slope is fixed in our setup which is 32^{o} in this case and it is most suitable for capturing incident radiation. A schematics of basic principle is shown in Fig this will illustrate various aspects of solar still at a glimpse.

3. EXPERIMENTAL

In the present study design and construction has done, a pictorial view of still dimension are shown as in figure. Wood as a material is used to construct main body of system, at the bottom water proof material is incorporated in order to prevent its leakage. The top of the wooden box is open at a slope to collect condensed water at the inner surface of Glass top ,at the lower side a pipe is fitted to collect the distil water. Aluminium is placed at the bottom of the still, Glass of 5 mm thickness is used for roof top of wooden box, thermacol is used as insulator material as well aluminium foil are taken in use as reflector inside the still . The slope is fixed in our setup which is 32° in this case and it is most suitable for capturing incident radiation.

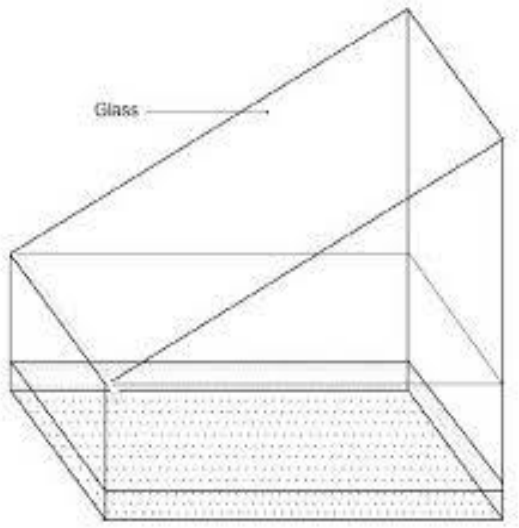


Figure-2-Schematic of Single Slope Solar Still

Pipes are used for collecting the distil water and supplying brackish water, most important thermocouples to measure temperature at top of glass and bottom of still and temperature of water inside the still, apart from this volume measuring units.

4. OPERATION

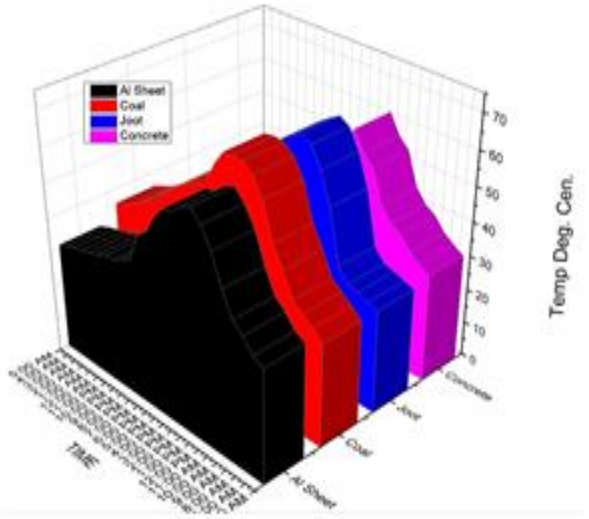
The still was installed on the top floor of building and tested at Agra Uttar Pradesh (27.1767° N latitude and 78.0081° E longitude) India with long axis of the still facing south-north direction with the aim to obtain maximum solar radiation. The setup has been under observation since morning at 6.00 a.m. to 5.00 a.m. within 24 hours with respect to local time during the month of May -June. The experimental procedure started with cleaning the glass sheet of the still. An arrangement has been done for proving brackish local water and a constant head 1.8 cm is maintained for whole day 1.8 by keeping supply of raw water continuously.

Under the operation various parameters like solar intensities, water temperature inside the still, temperature of still bottom and temperature of glass have been examined regularly at the interval of one hour throughout the duration of operation.

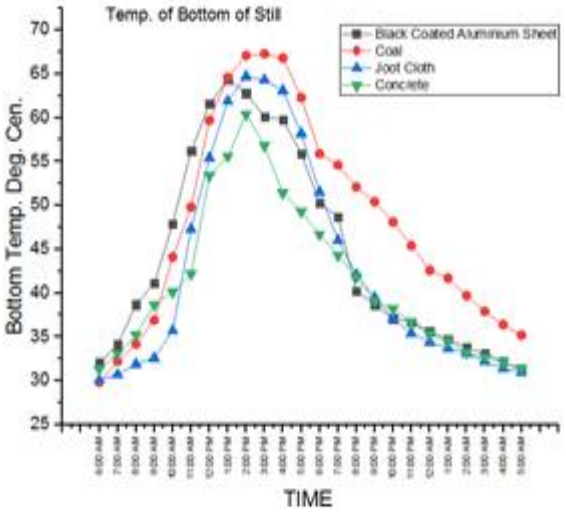
The observations have been done in two phases, in phase one top of glass is kept dry and one by one material as black coated aluminium, coal, joot cloth and concrete were placed for each set of reading. In the second phase of observation, same material was used but glass top is covered with thin film of water flower over it, again a set of reading has been noted.

The absorptive materials were used , tabulated as above with their properties ,and reading have been noted per hour basis as well 24 hours outcomes of distil water volume were recorded .This reading of data and yield of water have been recorded with and without water film over glass top

5. RESULT



Bottom Temperature variation versus time hour for different materials



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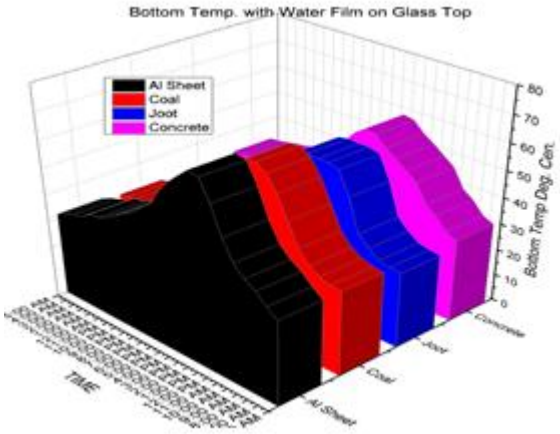
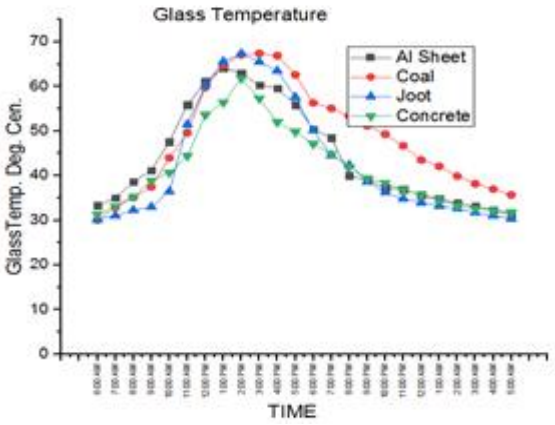
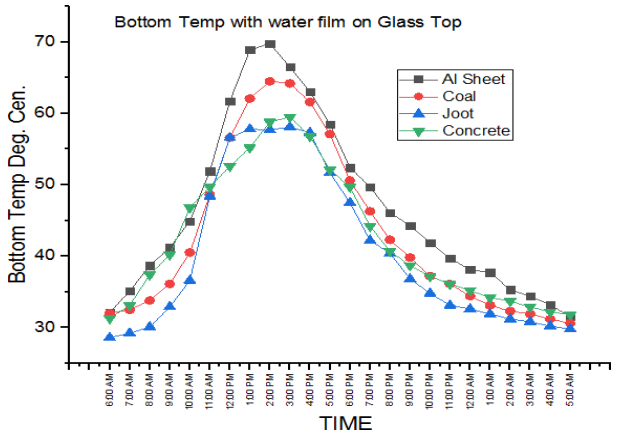


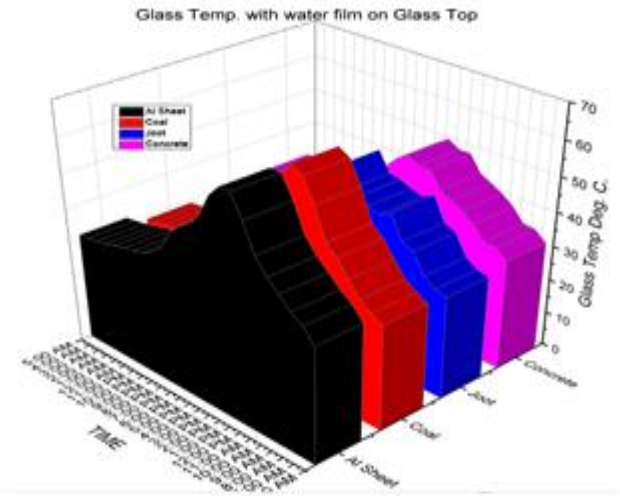
Bottom Temperature variation versus time hour for different materials with water film on Glass Top



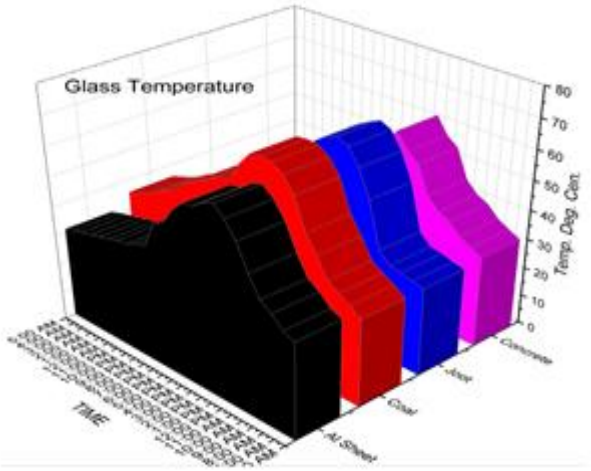
Glass Temperature variation versus time hour for different materials



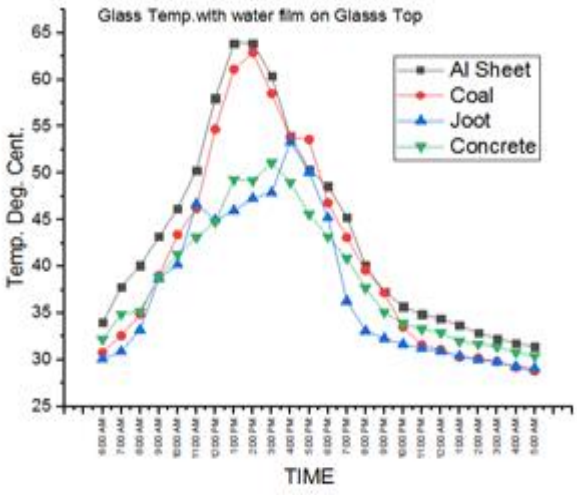
Bottom Temperature variations versus time hour for different materials with water film on Glass Top



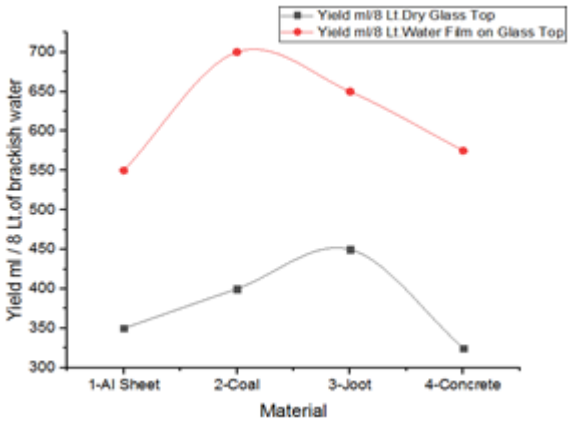
Glass Temperature variation versus time hour for different materials with water film at Glass Top



Glass Temperature variation versus time hour for different materials



Glass Temperature variation versus time hour for different materials with water film at Glass Top



Still water Yield with respect to different materials

6. CONCLUSIONS

The salient observation have been drawn to conclude the fact s from experimental study as

(1) The first operating of still with black coated aluminium sheet was conducted; water temperature is highest 64^{0}C as compare to bottom temperature and glass temperature (60^{0}C). When glass top is subjected with water flow, temperature range is hike with 69^{0}C for water and bottom surface of still and glass temperature attains the value of 63^{0}C, at the noon.

(2) When coal as a absorptive material was water temperature attained 67^{o}C and then they shows the difference in temperature such as when still was operated with coal at bottom. When still was operated with water film ,slight difference in temperature occur up to 11 am, then they separated by significant amount with bottom and water temperature this help to evaporation and condensation.

(3) When Joot cloth had taken as absorptive material and operated under normal condition. The glass temperature reached the value of 70^{o}C at 3 pm and bottom temperature attain 63^{o}C and water was at 64^{o}C. When the same system was operated with water film then it had maintain huge difference in temperature after that it was running along their values but lesser than them.

(4) The still water yielding for ,joot is 450 ml per 8 litre of brackish water a day and for coal gives 400 ml per 8 litre of brackish water a day in dry state of operation.

With water film application yielding was improved 700 ml per 8 litre of brackish water of still water was generated by coal and 650 ml per 8 litre of brackish water a day by joot.

As we compare the performance of potable water production mode of operating still system with water film is quite effective and even with black coated aluminium sheet and concrete gives better output 500 ml per 8 litre of brackish water and 575 ml per 8 litre of brackish water respectively ,which is highest yield of dry top operating condition.

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