

# International Journal of Innovative Research in Science, Engineering and Technology

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## Experimental Study on a Single Slope Solar Still: with and Without Internal Reflectors

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**ABSTRACT:** Water is basic necessity of man along with food. The fresh water crisis is already evident in many parts of India, varying in scale and intensity at different times of the year. India's rapidly rising population and changing lifestyles also increases the need for fresh water. The pollution of rivers and lakes by industrial effluents and sewage has added to the problem. The conventional desalination technologies are energy intensive, expensive for the production of small amount of fresh water and also has a negative impact on the environment. Seawater desalination is an important process to meet the increasing demand for fresh water. In the wake of present energy crises Solar distillation is most attractive and simple technique among other distillation processes and it is especially suited to small-scale units at locations where solar energy is considerable. India, being a tropical country is blessed with plenty of sunshine. The present work discusses experimental work carried out on solar still at MNIT Jaipur with and without internal reflectors and with varying water depth. The operational parameter such as depth of water in the basin is varied from 1 cm to 3 cm to find out its influence on the productivity and efficiency of the still. The results indicated that with increase in depth of basin water, still productivity decreases. The overall efficiency with the use of mirrors increased by approx 20%.

### I.INTRODUCTION

Water is the most abundant and important substance in nature. It is the principle component of life, health and sanitation. Even though water is one of the most abundant resources covering three-fourths of the planet's surface, about 97% of this volume is saline, and only 3% is freshwater suitable for humans, plants, and animals [3]. The fresh water crisis is already evident in many parts of India. Nearly one million children in India die of diarrhea diseases each year directly because of drinking unsafe water and living in unhygienic conditions. Some 45 million people are affected by water quality problems caused by pollution, by excess fluoride, arsenic, iron or by the ingress of salt water. Millions do not have adequate quantities of safe water, particularly during the summer months. In rural areas, women and girls still have to walk long distances and spend up to four hours every single day to provide the household with water [1]. It is projected that close to 70% of the world population will face water shortage issues by 2025 [5] and approximately 50% of the world's population lives within 200 km of the coast.[6] Every year 3,575,000 people die from water related diseases[8]. Provision of clean water inevitably requires energy, which is currently being provided by non-renewable fossil fuels. Escalating global demand for clean water supply for the future will significantly accelerate depletion of fossil fuel reserves and emission of greenhouse gas emissions. The solution to this dilemma is to develop renewable and sustainable approaches that rely on inexhaustible water sources and renewable energy or waste heat sources that do not cause any environmental harm [7]. Desalination of brackish water and seawater to provide the needed drinking water fulfils a basic social need and it does this without any serious impact on the environment. Hence solar distillation provides partially support to humanity's needs for fresh water with free energy, simple technology and clean environment. Solar stills have a good chance of success in India for lower capacities which are more than 20 km away from the source of fresh water and where the TDS of saline water is over 10,000 ppm or where seawater is to be desalted [4].

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## II.SYSTEM DESCRIPTION

A single slope solar basin was designed and constructed. The unit consists of:

- (A) Basin: Material: GI sheet, 24 gauge, Length: 1m, Width :0.8m, Effective area: 0.8 sq.m
- (B) Glass: Type: Ordinary, Thickness: 5mm, Angle of inclination: 36 degree
- (C) Insulation: Thermocol, 2.54cm (around and below the basin)
- (D) Basin Liner: Black Japanese paint
- (E) Temperature Indicator: T- Thermocouple

In order to perform experimental tests, set up is developed as shown in figure1. The still is simply a basin made of GI sheet. Its top is covered by a plane window glass of 5mm. The basin is painted black to increase solar absorptivity. All the sides and base is insulated with thermocol to minimise the heat loss to the ambient. A collection channel is fixed to the lower side of glass in still to collect condensed water. A plastic beaker is used to measure the hourly yield through daytime. PVC and hosepipes are used to discharge the distillate from the still. Five thermocouples are used to measure temperature at different locations. Thermocouple 1 is submerged in water to measure water temperature. Thermocouple 2 is placed inside the basin close to glass top not touching the top to read water vapour temperature. Thermocouple 4 is placed inside in the centre of glass to read glass inside temperature. . Thermocouple 5 is kept in the atmosphere to read ambient temperature. A solarimeter was used to find solar radiations falling on glass.



Fig.1 Solar still set up

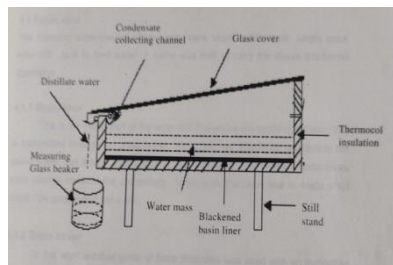


Fig.2 Schematic of experimental set up

## III.RESULTS AND DISCUSSION

The experiments were conducted for different water depths with and without internal mirrors in the still to investigate the effect of water depth on productivity and efficiency. Readings at 1 hour interval for different combinations were recorded from 9a.m. to 6pm. Results of the experimental analysis are as:

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### [1] Variation of distillate output with and without mirrors w.r.t. time.

Chart 1 shows plot of distillate output with and without mirrors with time. From the analysis it is observed that output increases with time i.e. at starting of day productivity is minimum and as the day passes it reaches its peak value and then declines. This is due to the fact that solar radiation intensity is less in the morning time. Maximum productivity is obtained between time period 1.00-3.00p.m. corresponding to higher solar radiations. It is also observed that productivity with the use of internal mirrors is more than that without mirrors because mirrors make use of energy reflected on all sides of solar still.

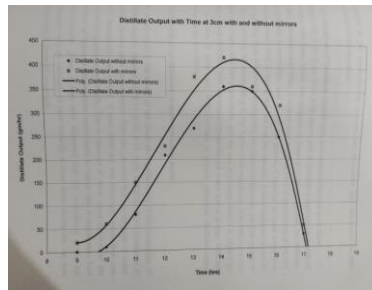


Chart 1 Distillate output with and without mirrors w.r.t. time.

### [2] Variation of distillate output with water depth.

The water in the basin of still plays an important role in the production of output. Chart 2 shows plot of distillate output with water depth. One can observe that an increase in water depth decreases the output. Maximum production was attained at lowest water depth this is because at lower water depth solar still operates at higher temperature which leads to higher rate of evaporation from water towards glass.

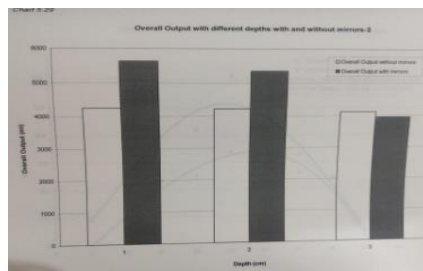


Chart 2 Distillate output with water depth.

### [3] Variation of efficiency with time and water depth.

Chart 3 shows plot of efficiency with time and water depth. It was observed that instantaneous efficiency is minimum at the starting, attains maximum value and then declines. It is found that still efficiency increases with increase in quantity of water in the basin because heat capacity increases with increase water depth. The overall efficiency decreases with increase in water depth.

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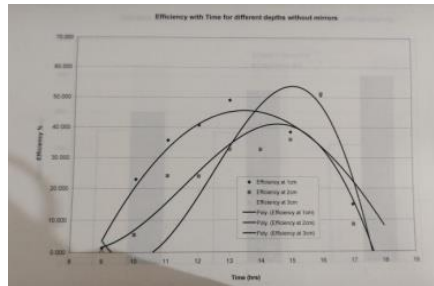


Chart 3 Efficiency with time and water depths without mirrors

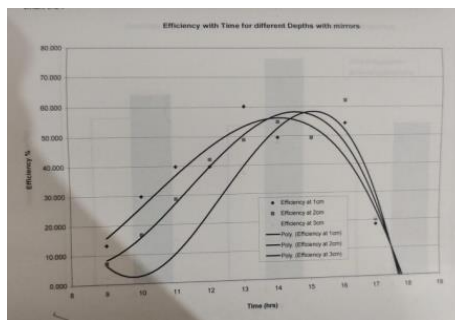


Chart 4 Efficiency with time and water depths with mirrors

## IV.CONCLUSION

The results could be summarized as follows:

1. Maximum output is obtained for 1cm water depth with and without mirrors.
2. Overall efficiency is maximum for 1cm water depth with mirrors (88%) and is nearly same at 1cm and 3cm without mirrors (60%)
  - (a) With the use of mirrors in the still the output increases by approx. 2.0 lts
  - (b) The overall efficiency with the use of mirrors increases by approx 20%

## REFERENCES

- [1] Status of solar desalination in India, Arjunan , H.S. Aybar , N. Nedunchezian, Renewable and Sustainable Energy Reviews Volume 13, Issue 9, December 2009, Pages 2408-241
- [2] A comprehensive techno-economical review of indirect solar desalination, Muhammad Tauha Ali, Hassan E.S. Fath, Peter R. Armstrong, Renewable and Sustainable Energy Reviews Volume 15, Issue 8, October 2011, Pages 4187-4199
- [3] Review of researches and developments on solar, A.E. Kabeel, S.A. El-Agouz, Desalination Volume 276, Issues 1–3, 2 August 2011, Pages 1-12
- [4] Solar-thermal powered desalination: Its significant challenges and potential, John H. Reif , Wade Alhalabi, Renewable and Sustainable Energy Reviews Volume 48, August 2015, Pages 152-165
- [5] Desalination: Water from Water: Jane Kucera First published:31 January 2014



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- [6] Solar assisted sea water desalination: A review, Chennan Li, Yogi Goswami, Elias Stefanakos, Renewable and Sustainable Energy Reviews Volume 19, March 2013, Pages 136-163
- [7] Desalination using solar energy: Towards sustainability, Veera Gnaneswar Gude , Nagamany Nirmalakhandan<sup>a</sup>, Shuguang Deng, Energy Volume 36, Issue 1, January 2011, Pages 78-85
- [8] The World Counts • Impact through Awareness *Insights • Facts • Figures • Live Statistic*
- [9] Opportunities for solar water desalination worldwide: Review, Mahmoud Shatat, Mark Worall, Saffa Riffat Sustainable Cities and Society Volume 9, December 2013, Pages 67-80