A dual degree project presentation on

Design Parameter Analysis of a Single-Effect Solar Still

by

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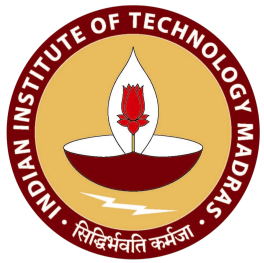

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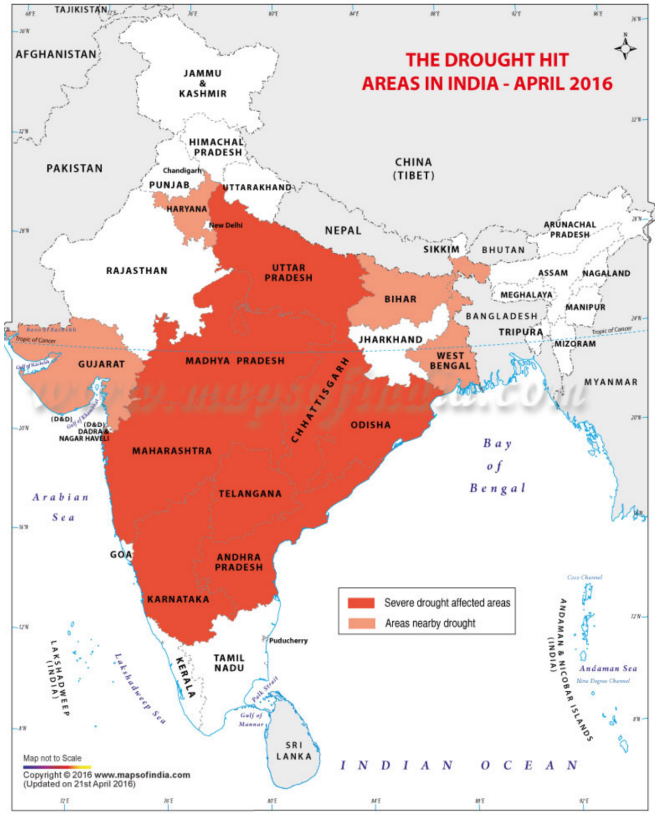
Motivation

Water shortages in rural India are caused primarily due to:

- Prohibitively expensive purification equipment
- Lack of electricity and/or water supply
- Scale of implementation of solutions



A map showing the drought impacted regions in 2016 (as reproduced from: [Maps of India, 2017])

Objectives and Scope

Objectives:

- Determine the most significant design parameters
- Water production target of **5 L/m^2 per day**

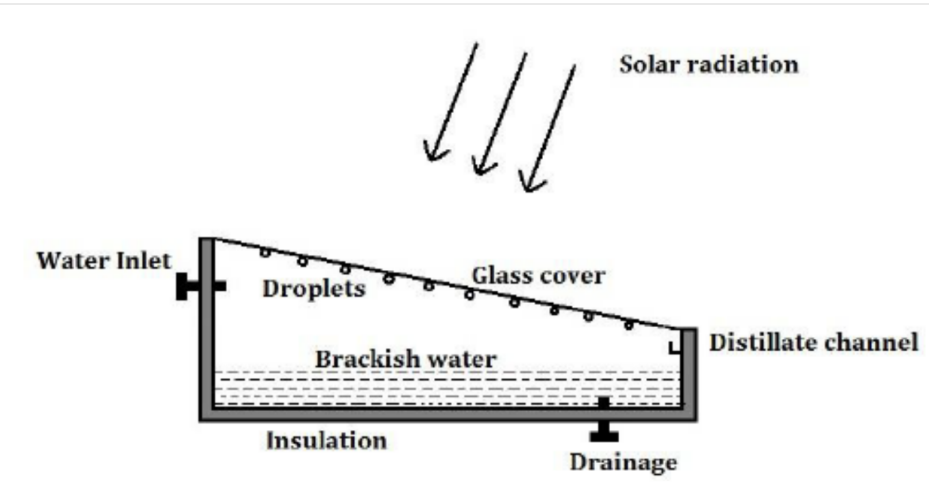
Scope:

- Single-effect solar stills
- Flat and inclined basins
- No active, power-consuming elements

Theoretical model of a Single-Effect Solar Still

The critical thermodynamic processes are:

- Absorption of energy by water on the basin
- Evaporation of water from the basin
- Condensation of water on the top cover

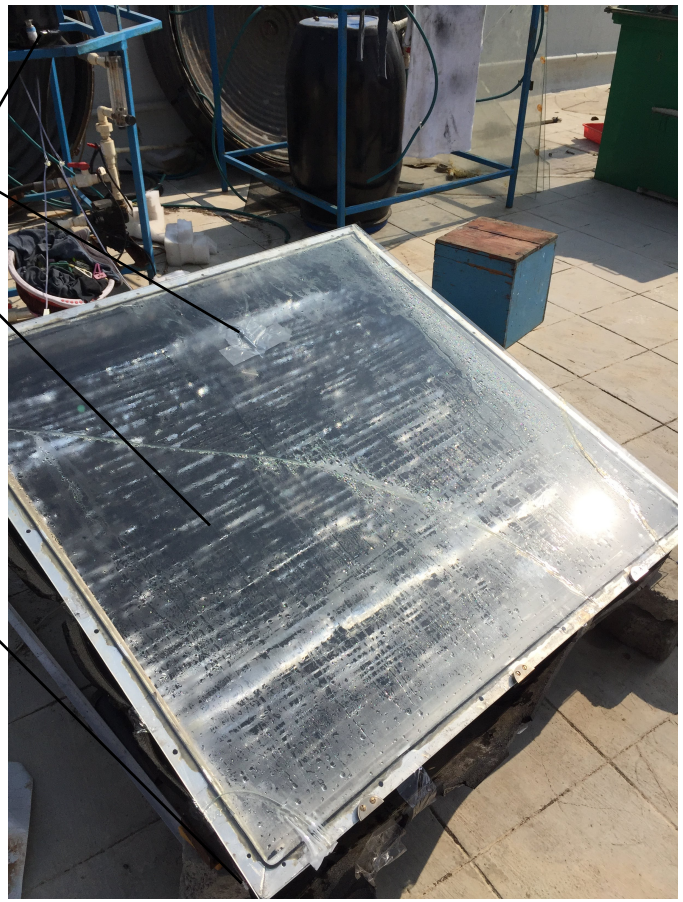


A simple schematic of a single basin solar still (reproduced from [Jamil and Akhtar, 2014]).

Prototyping

The important design parameters were:

- Basin size and orientation
- Basin material
- Material for augmenting heat absorption
- Thermal insulation
- Top cover material

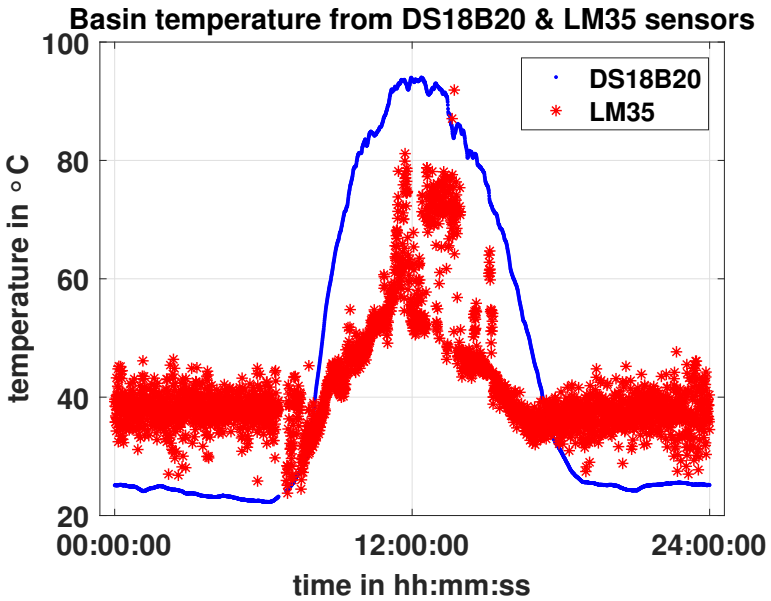


The prototype used for testing, with key elements marked.

Prototyping

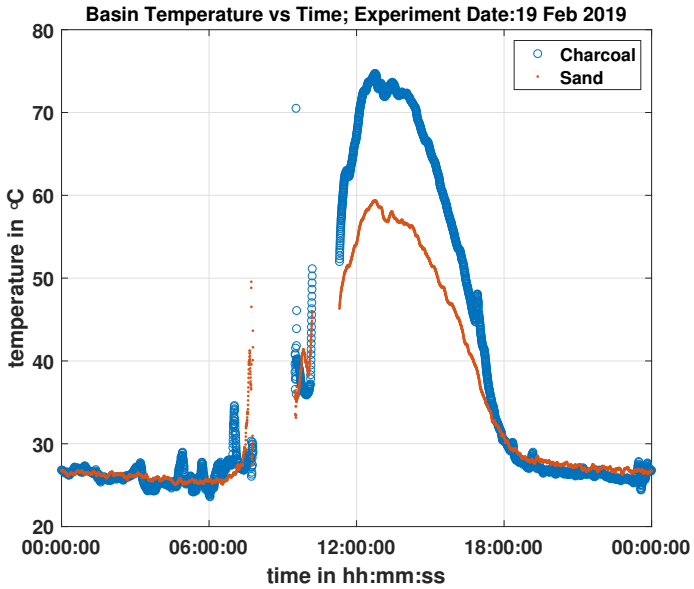
Some issues faced in the prototyping of the still were:

- Lack of basin stiffness
- Noise in the LM 35 sensor
- Top cover design

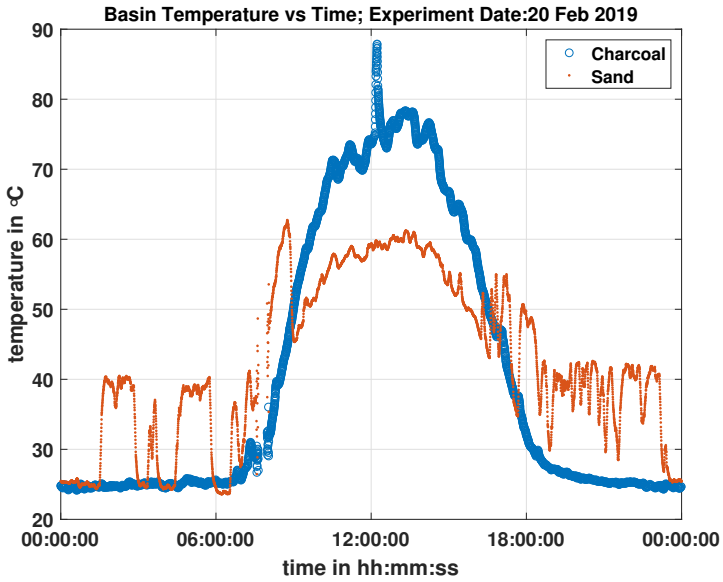


A comparison of the raw data collected from the DS18B20 and LM35 temperature sensors.

Experiment 1: Sand vs Charcoal



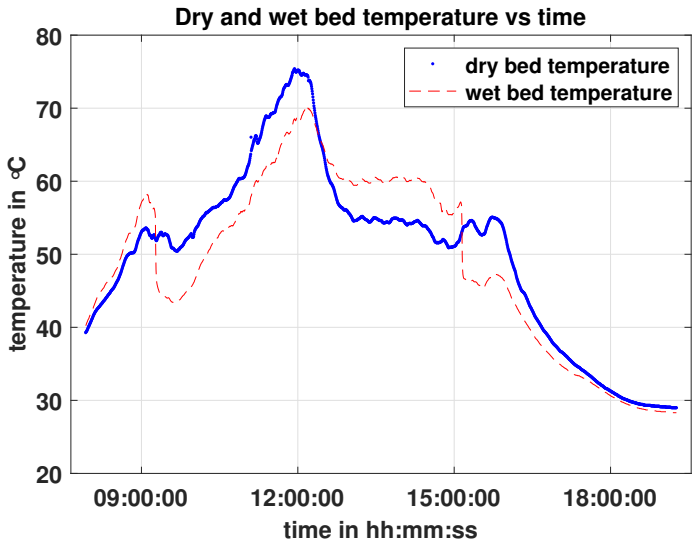
Basin temperature plots vs time, data collected on 19th February.



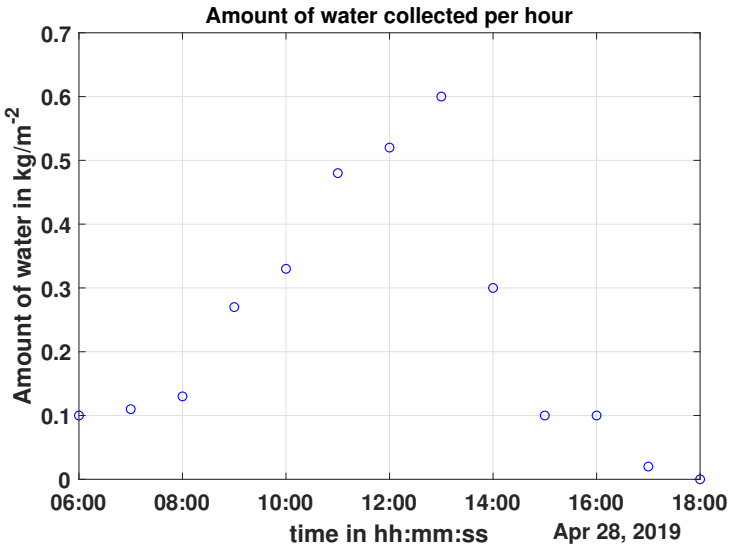
Basin temperature plots vs time, data collected on 20th February.

The plots show the basin bed temperature against time, when charcoal and sand are used to improve the heat absorption.

Experiment 2: Basic Still without appendages



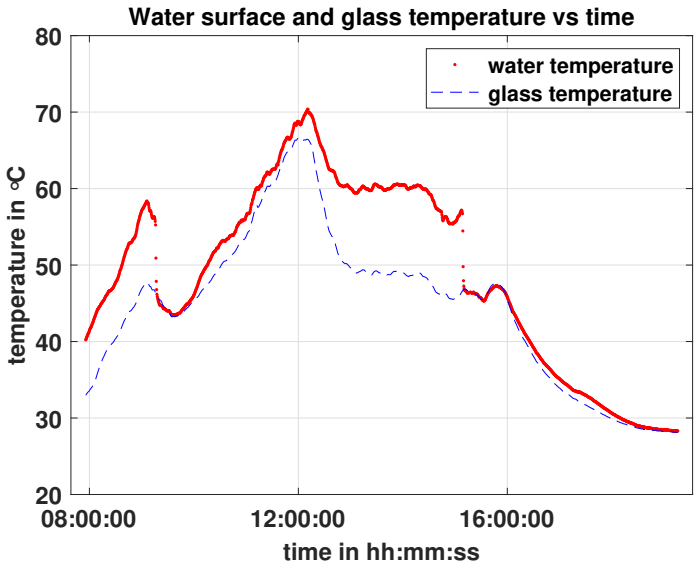
A comparison of the basin bed temperature with and without water.



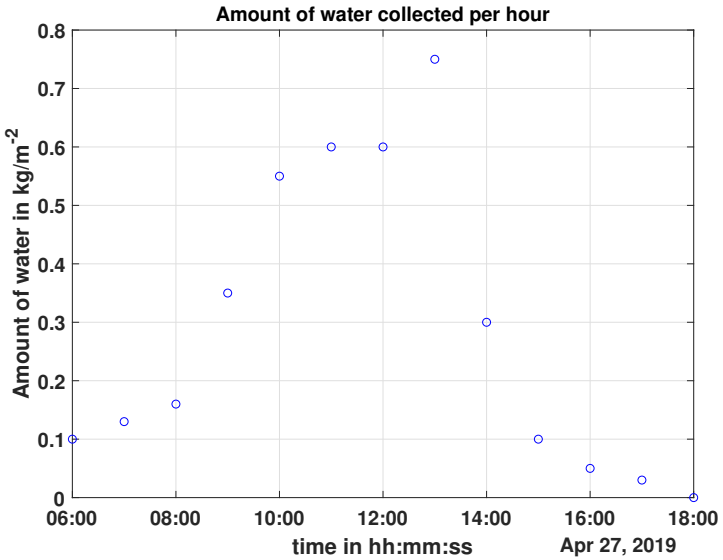
A measure of the hourly water quantity generated by the still

This experimental setup yielded **3.1 L/m^2 per day** of distilled water.

Experiment 3: Still with continuous water supply



A comparison of the water surface temperature and top glass temperature.



The amount of water collected from the still with a steady water supply provided to the basin.

This experimental setup yielded **3.8 L/m^2 per day** of distilled water.

Conclusions

Still operational condition	Inclined-basin solar still output (in L/m^2 per day)	Flat-bottom solar still output (in L/m^2 per day), as sourced from [Pednekar et al., 2018]
Basin with charcoal	3.1	2.2
Basin with charcoal and continuous water supply	3.8	4.2

A comparison of the water output from the inclined basin prototyped in this work and a conventional flat-bottomed still discussed in [Pednekar et al., 2018].

Thank you all for your attention!

Any questions/comments?


Jamil, B. and Akhtar, N. (2014).
Desalination of Brackish Water using Solar Stills-A Review.


Maps of India (2017).
Drought Affected Areas in India 2016.
[Accessed on 2019-04-14].


Pednekar, A. M., Bandyopadhyay, S., and Chatterjee, D. (2018).
Performance Evaluation of Solar Still.
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