تحت رعاية معالي رئيس مجلس الوزراء المصري المهندس شريف إسماعيل
مؤتمر تحلية المياه الحادي عشر في البلدان العربية
UNDER THE PATRONAGE OF THE EGYPTIAN PRIME MINISTER ENGINEER SHERIF ISMAIL
11TH WATER DISALINATION CONFERENCE IN THE ARAB COUNTRIES
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Effects of concentrator type and encapsulated phase change material for solar desalination: Integration meets Enhancement

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INSIDE…

- Introduction
- Objectives
- Proposed system configuration
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ANCIENT CONCEPT OF WATER- QUR'AN

In the Qur'an of life, Life in the Universe is water based.

No water, No life. *[Quran 21.30]*

Number of times the word "land" appears in the Qur'an = 13

Number of times the word "sea" appears in the Qur'an = 32

Proportion of dry land to sea covering the Earth = 13/45 = 29%

Proportion of sea to dry land on Earth = 32/45 = 71%

[Ref. : http://www.speed-light.info/miracles_of_quran/water.htm]

ANCIENT CONCEPT OF WATER- INDIA

"The duties of life cannot be discharged by any person without water, so without rain there cannot be the flowing in water" says *Thirukural*, written by the saint *Thiruvalluvar* approximately 2,200 years ago in Tamilnadu *.

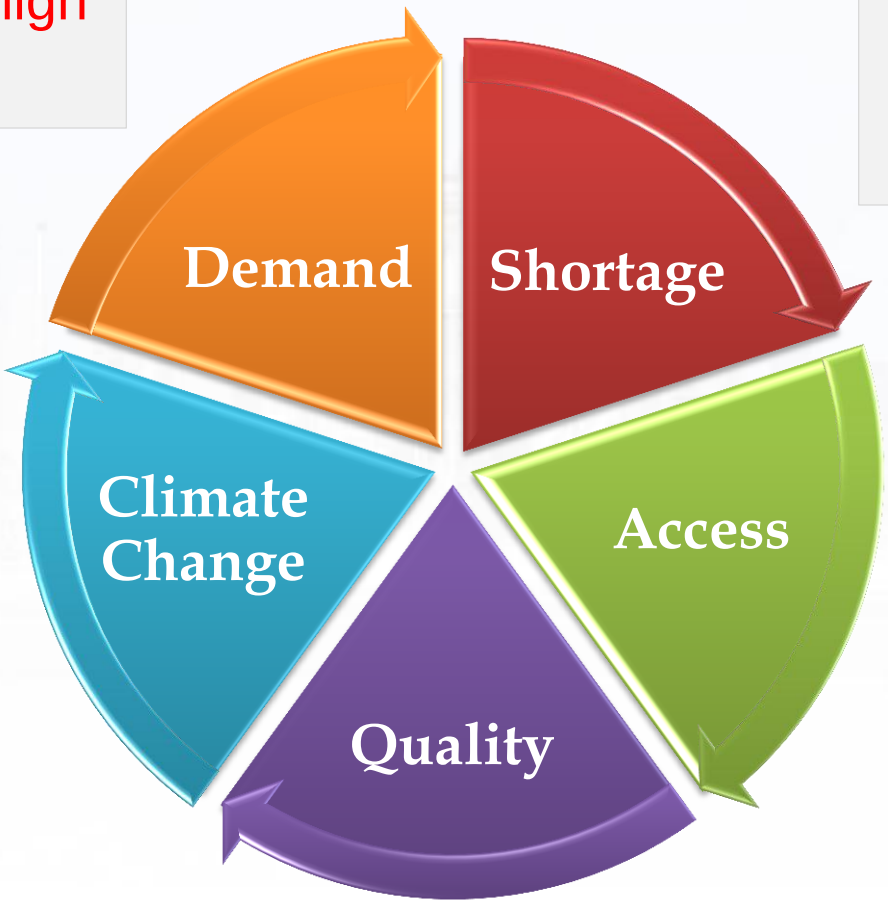
This passage clearly indicates the importance of water and well matched with the present situation. Nowadays, the need to fresh water is more due to the remarkable growth of population which leads to shortage of natural water resources.

**Ref.: https://en.wikipedia.org/wiki/Tirukkural*

INDIA'S WATER CHALLENGES

***54%** of India faces high to extremely high water stress

***More than 100 Million people have access to poor quality of water**



*** 54% of India's ground water wells are decreasing**

#Every year **6,00,000** Indian children died due to lack of access fresh water

Ref: World water resource institute

INDIA'S WATER DESALINATION PROJECTS

Startup year	Location	Raw water	Technology	Product	Capacity
2003	Chennai Metropolitan Development Authority Koyumbedu, Chennai	Brackish water	Reverse Osmosis	Drinking water	200 m^3/d
2009	Hindustan Petroleum Corporation Limited (HPC)	Sea water	Reverse Osmosis	Process water	3,600 m^3/d
2010	Adani Power, Mundra Port SEZ, Gujarat	Sea water	Reverse Osmosis	Drinking water	20,000 m^3/d
2012	Chennai Metropolitan Water Supply and Sewerage Board Nemmeli	Sea water	Reverse Osmosis	Drinking water	1,00,000 m^3/d
2012	Tata Projects Limited (for Andhra Pradesh Power Development Company Limited)	Sea water	Reverse Osmosis	Drinking water	6,000 m^3/d

INDIA'S WATER DESALINATION PROJECTS

Startup year	Location	Raw water	Technology	Product	Capacity
2002	Chennai Metropolitan Development Authority Ayodyakuppam, Chennai	Brackish water	Reverse Osmosis	Drinking water	150 m^3/d
2002	Chennai Metropolitan Development Authority Nochikuppam, Chennai	Brackish water	Reverse Osmosis	Drinking water	150 m^3/d
2001	Gujarat Water supply and sewarage board Bhuj, Gujarat	Brackish water	Reverse Osmosis	Drinking water	100 m^3/d
2001	Gujarat Water supply and sewarage board Bhuj, Gujarat	Brackish water	Reverse Osmosis	Drinking water	100 m^3/d
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POSSIBLE SOLUTIONS

- A sustainable, innovative and economic way of approach is required to meet these demands.
- Meeting these demands through Renewable Source of Energy particularly solar energy provides substantial benefits to our society.
- A solar concentrator assisted desalinating systems are one of the best possible economic solution for production of potable water.

OBJECTIVES

In this work, solar desalinating systems are powered by concentrators and equipped with energy storage materials for fresh water enhancement.

ROLE OF CONCENTRATORS IN THIS WORK

- ✓Avoid the warm up time in the distiller
- ✓To rise the water temperature in short duration

PHASE CHANGE MATERIALS (PCMs)

When a material melts, it absorbs the heat; when it changes to a solid, it releases this heat. This phase change is used for storing heat in PCMs. In this work, Paraffin wax is used here to store the heat energy.

LIST OF ABBREVIATIONS

CCC	-	Compound Conical Concentrator
CPC	-	Compound Parabolic Concentrator
SSSS	-	Single Slope Solar Still
PSS	-	Pyramid Solar Still
CCTSS	-	Concentric Circular Tubular Solar Still
PCM	-	Phase Change Material

DETAILS OF EXPERIMENT

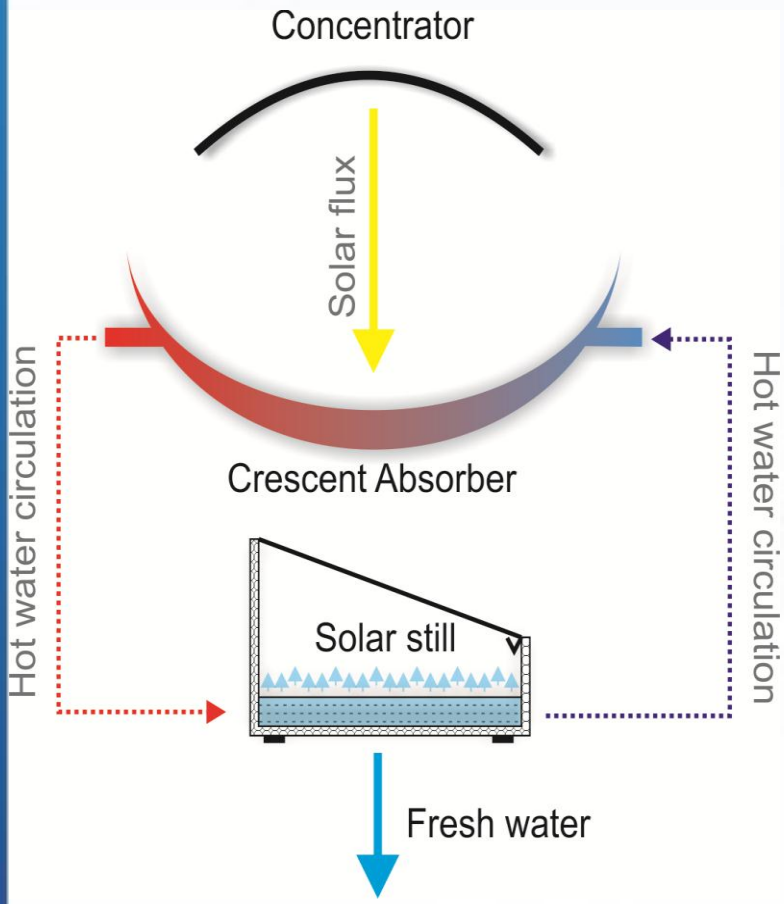
PART-1

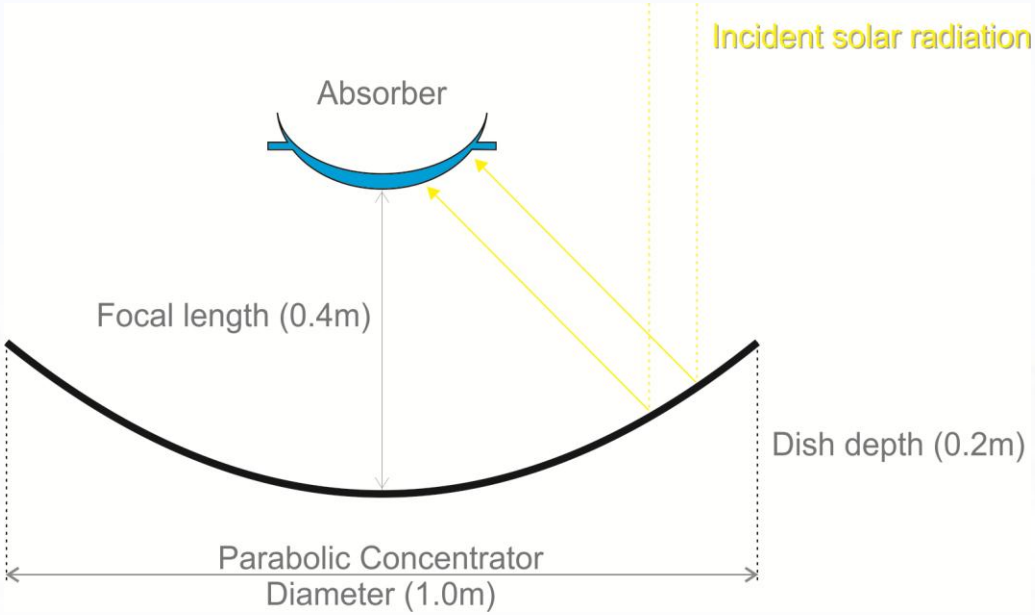
1. CCC-SSSS
2. CCC-SSSS WITH PCM
3. CCC-SSSS WITH PCM – TOP COVER SHADED

PART-2

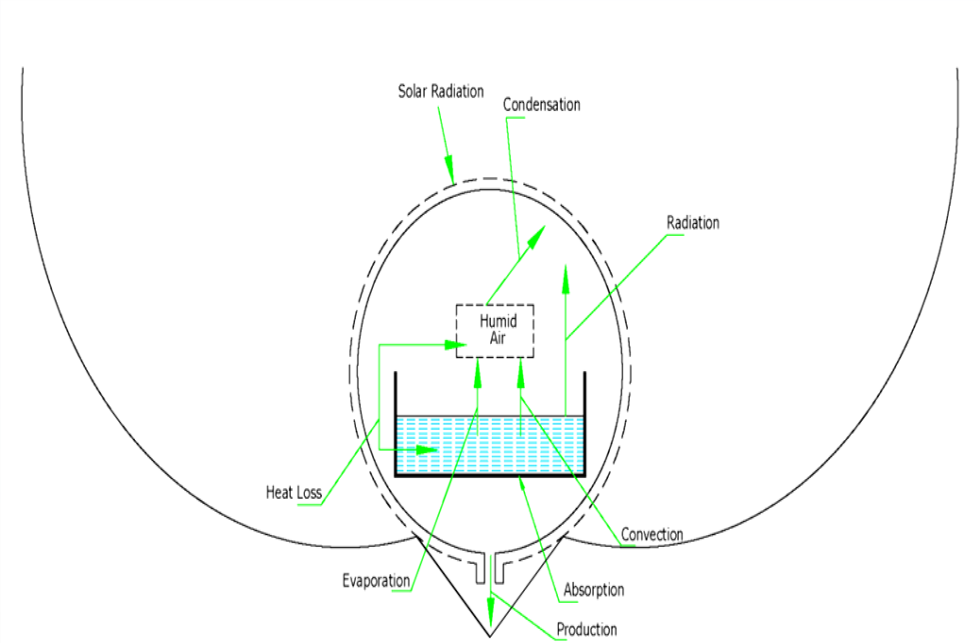
1. CPC-CCTSS
2. CPC-CCTSS-PSS WITH PCM
3. CPC-CCTSS WITH PCM – TOP COVER SHADED

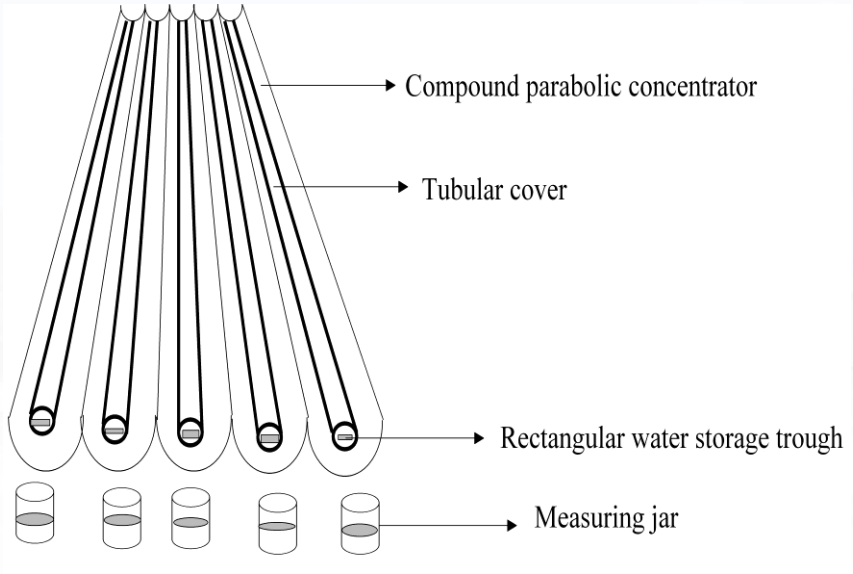
MECHANISM OF CCC-SSSS





MECHANISM OF CPC-CCTSS





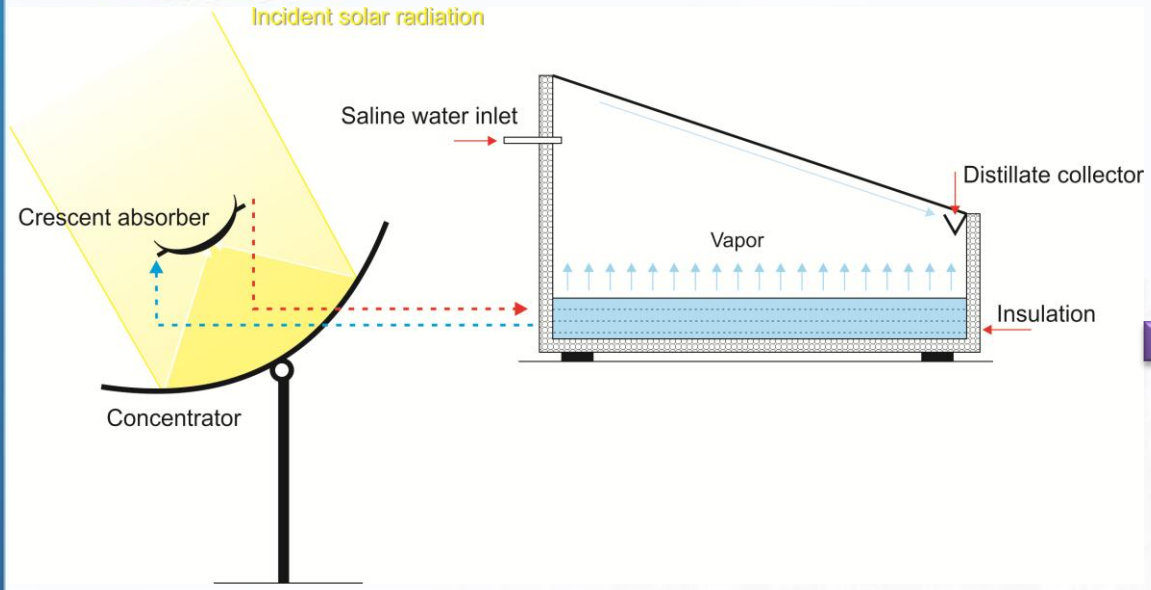
PROPOSED SYSTEM CONFIGURATION

Pyranometer

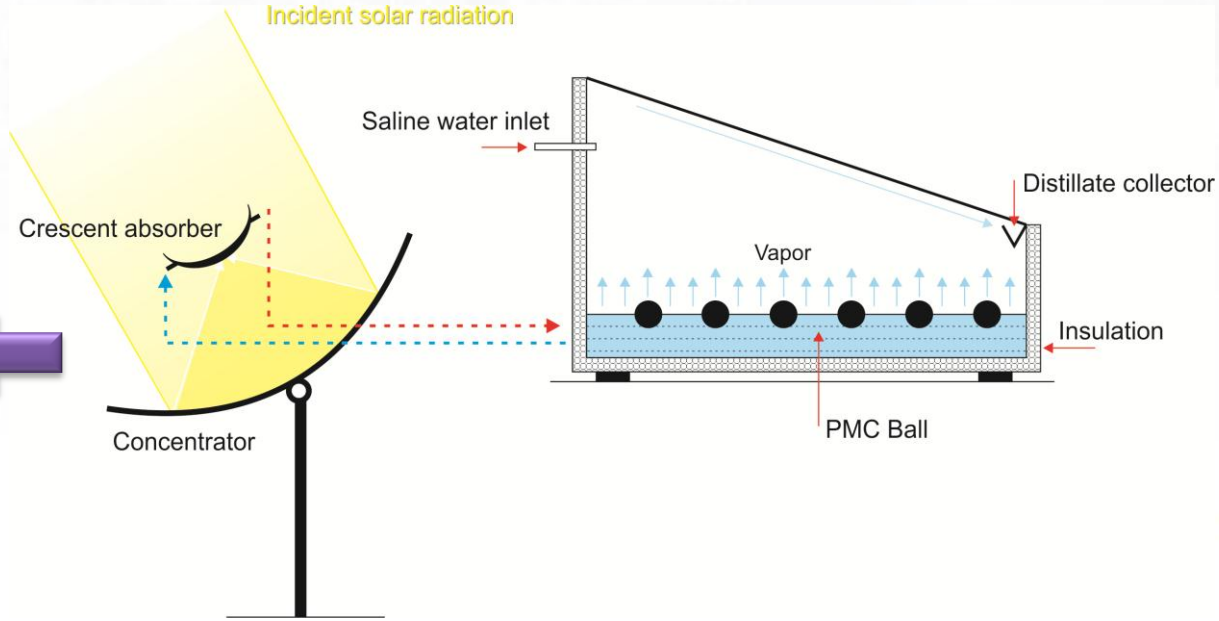
PART - 1

CCC-SSSS WITH PCM

PROPOSED SYSTEM CONFIGURATION

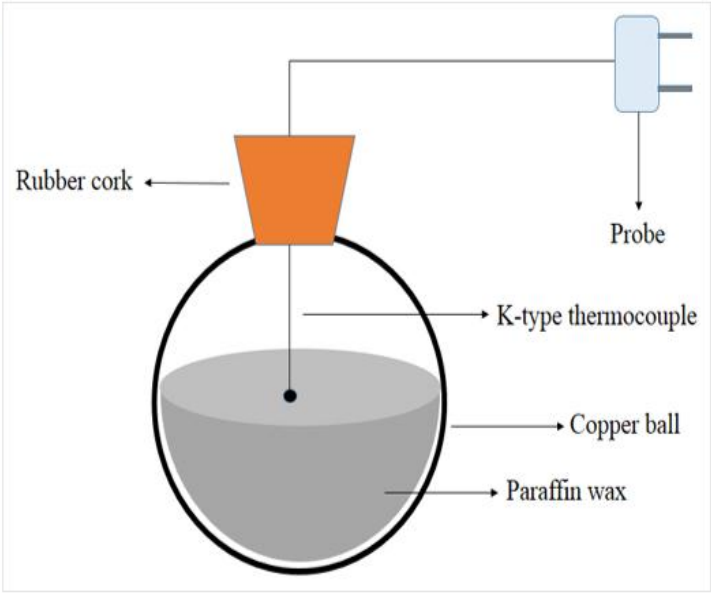


CCC-SSSS



CCC-SSSS integrated with PCM

PROPOSED SYSTEM CONFIGURATION



PCM balls in the solar still

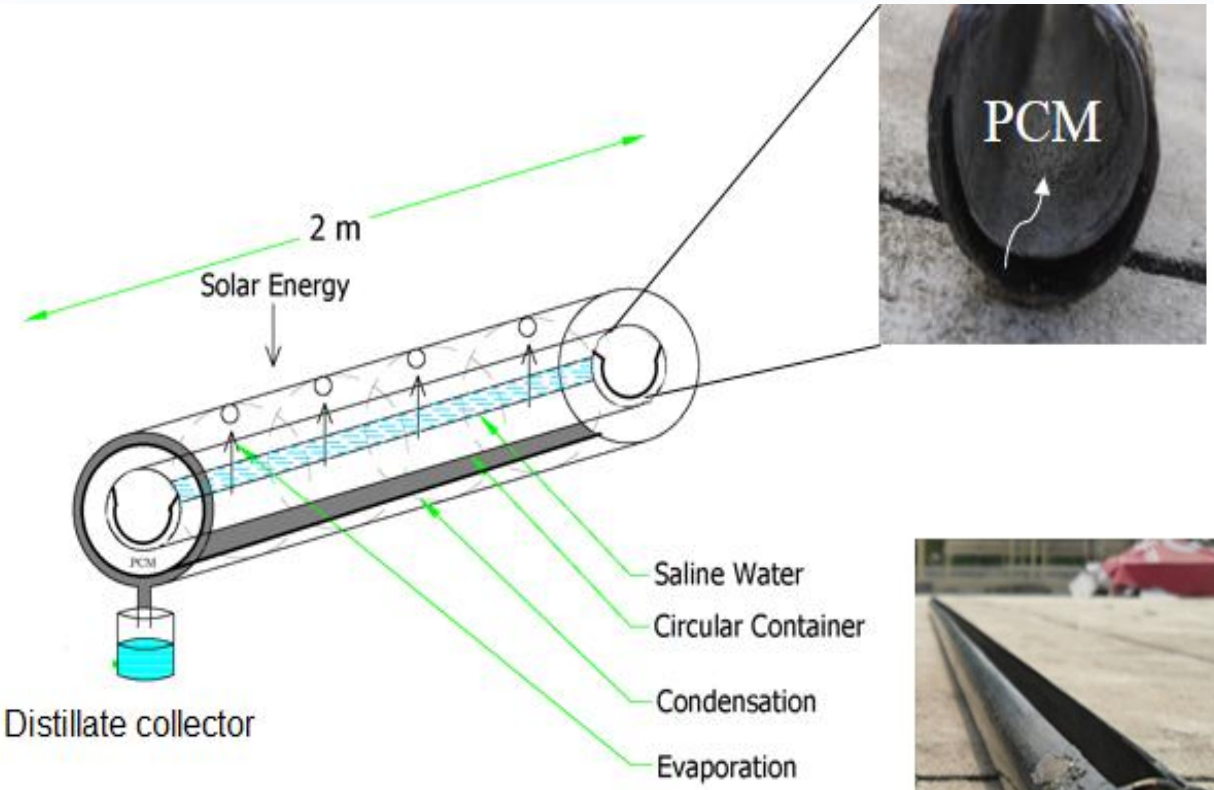
PROPOSED SYSTEM CONFIGURATION

CCC-SSSS and Top cover shaded

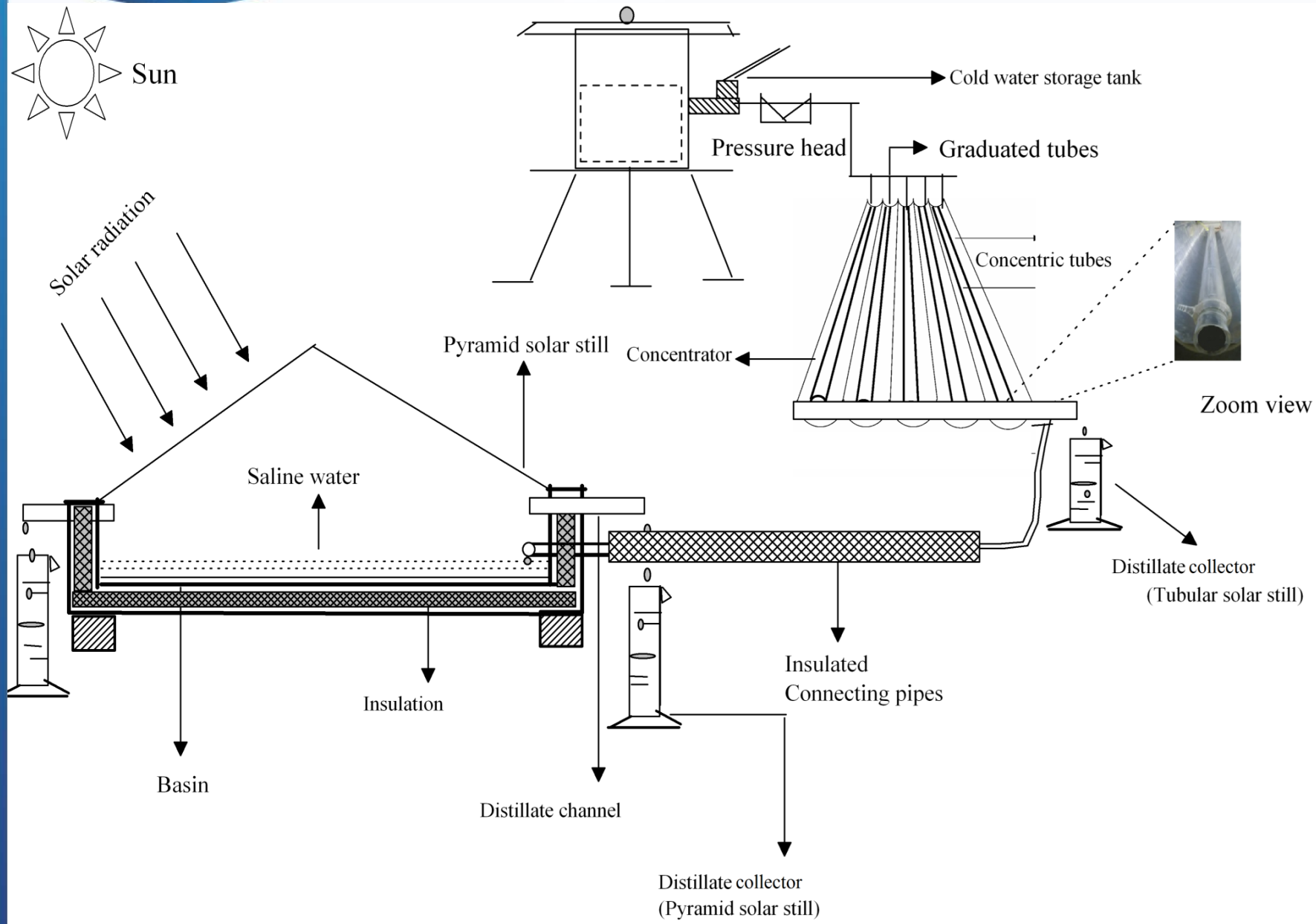
PART-2

CPC-CCTSS WITH PCM

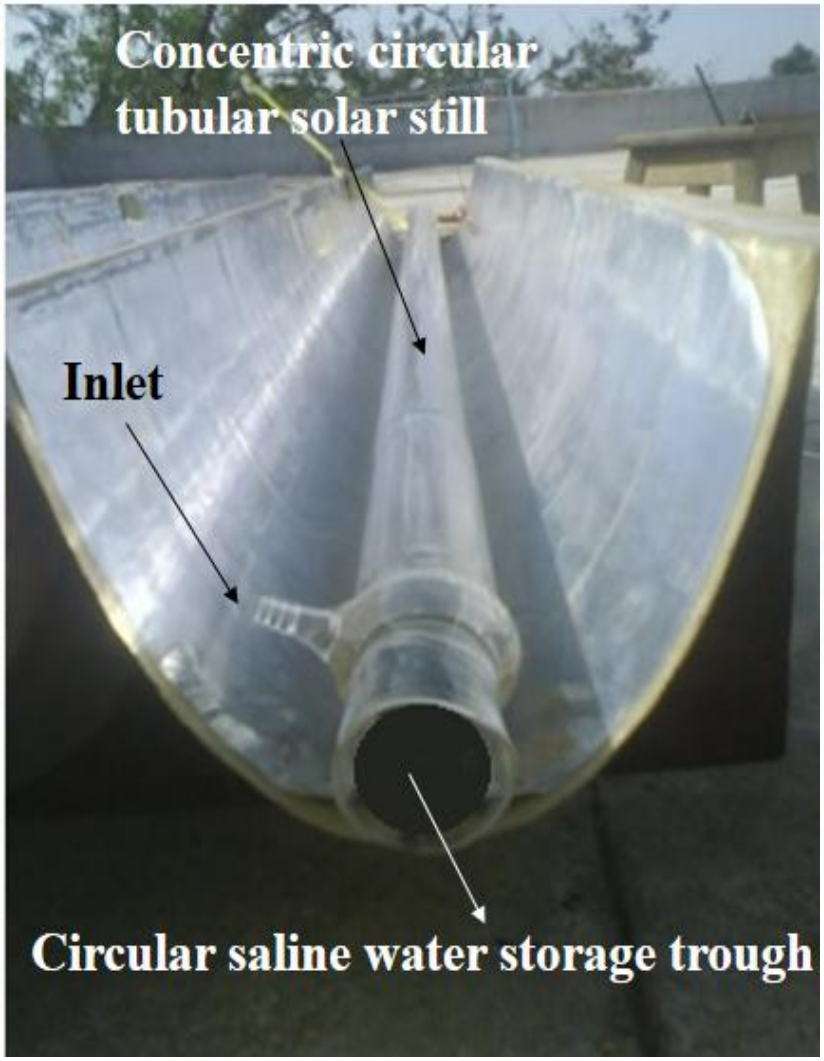
PROPOSED SYSTEM CONFIGURATION



PROPOSED SYSTEM CONFIGURATION

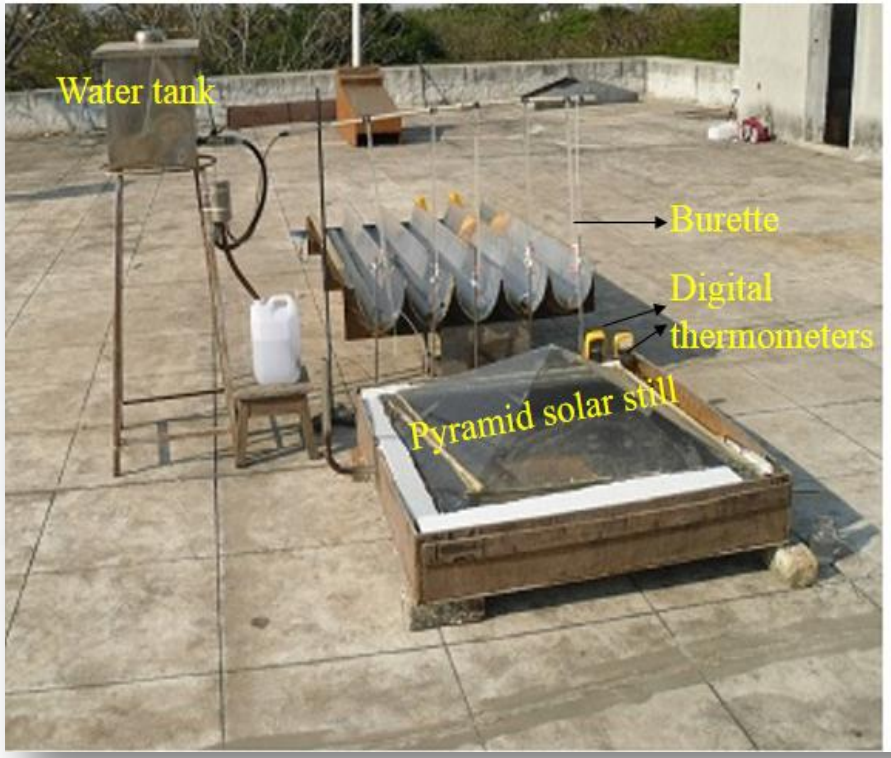


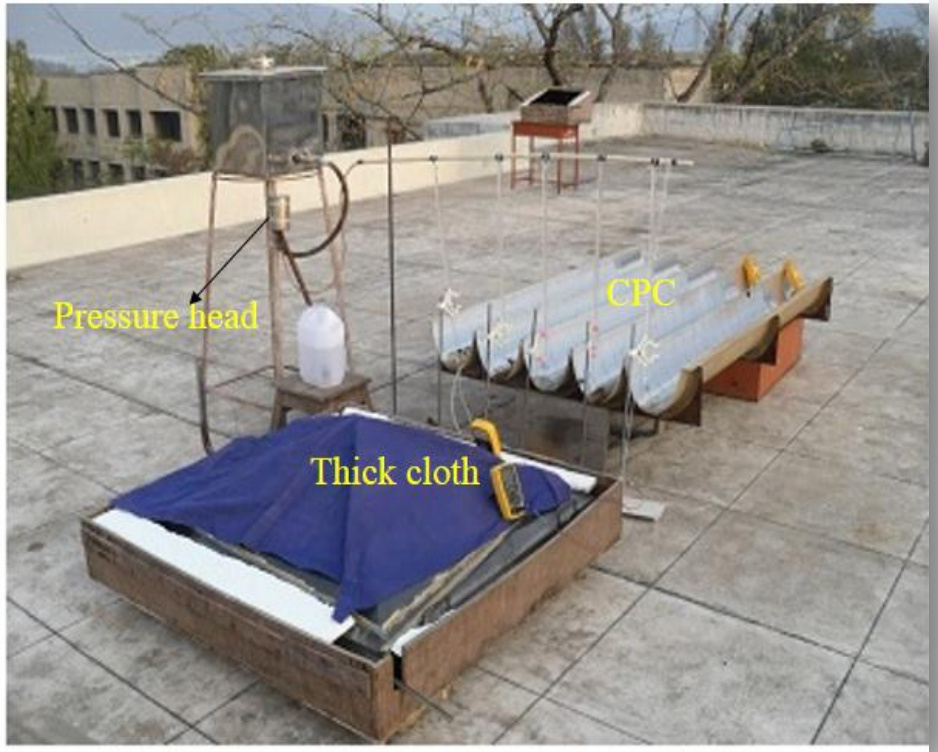
PROPOSED SYSTEM CONFIGURATION



CLOSE-UP VIEW OF CPC-CCTSS

PROPOSED SYSTEM CONFIGURATION





RESULTS

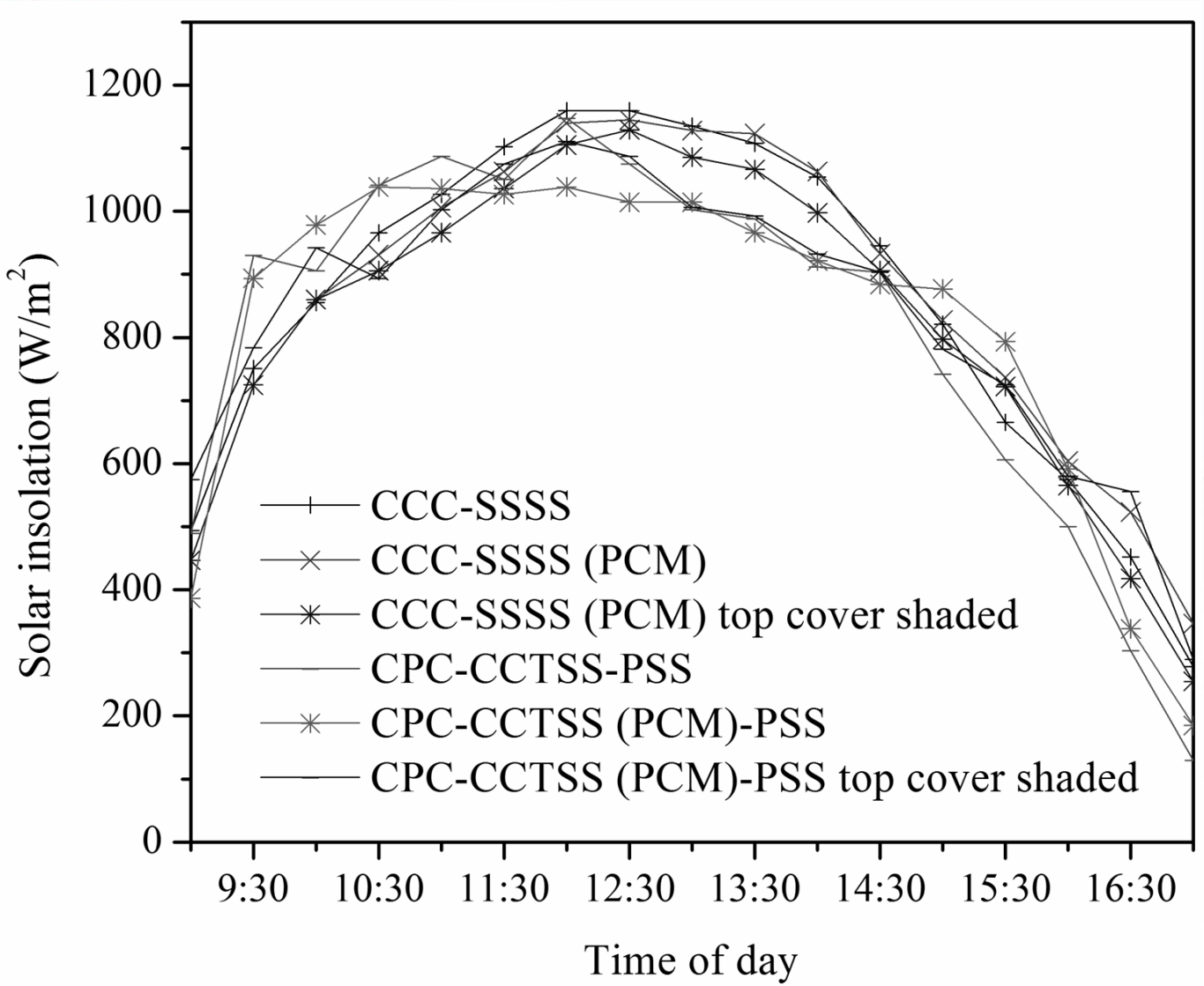
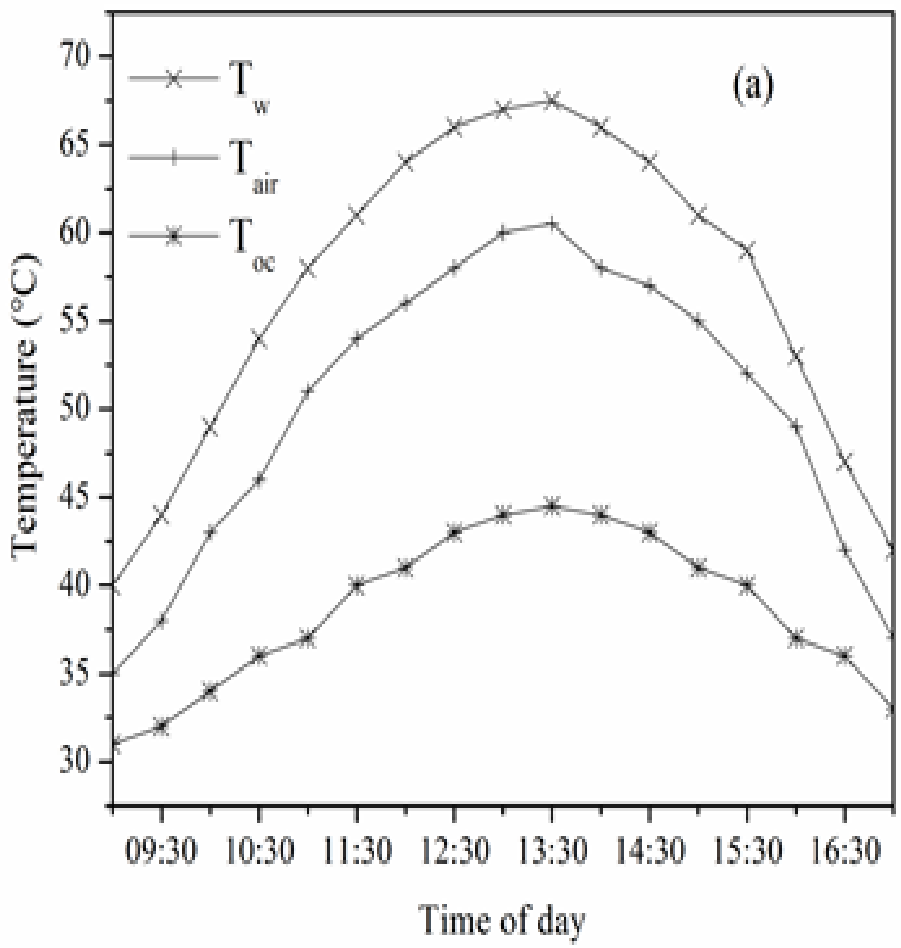


Fig. 1 Solar radiation with respect to time



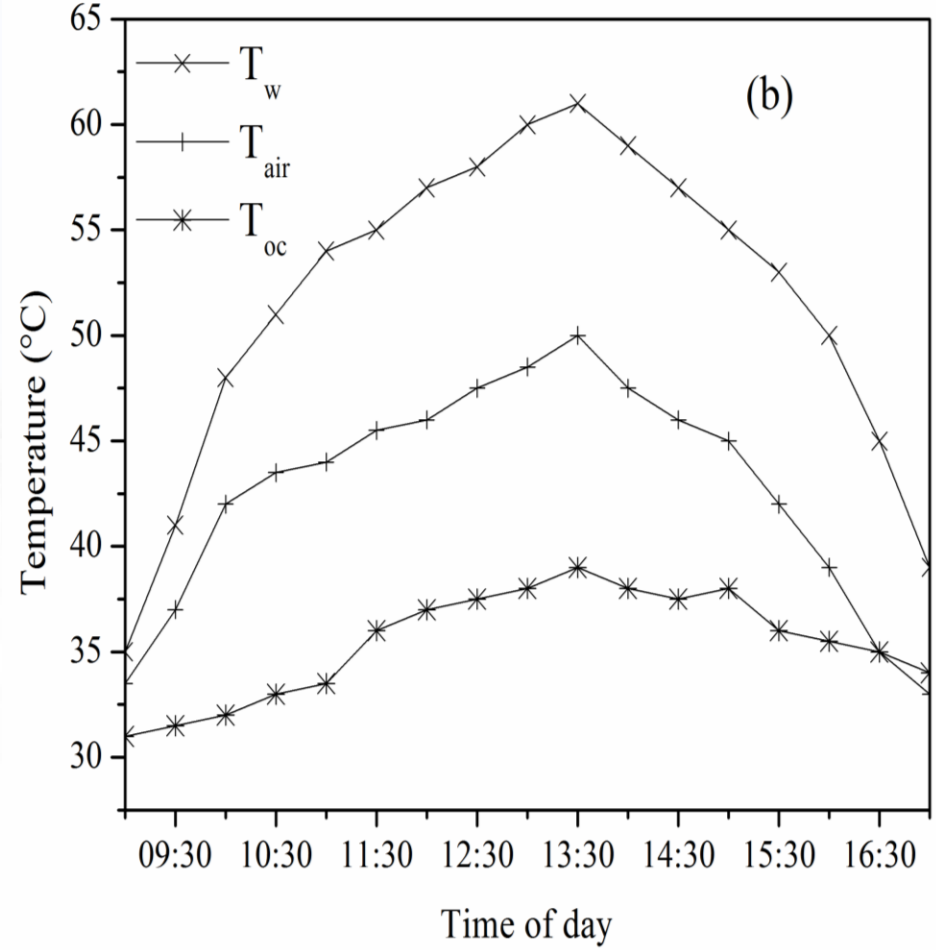


Fig 2. (a) Temperature of CCC-SSSS and (b) CCC-SSSS top cover shaded

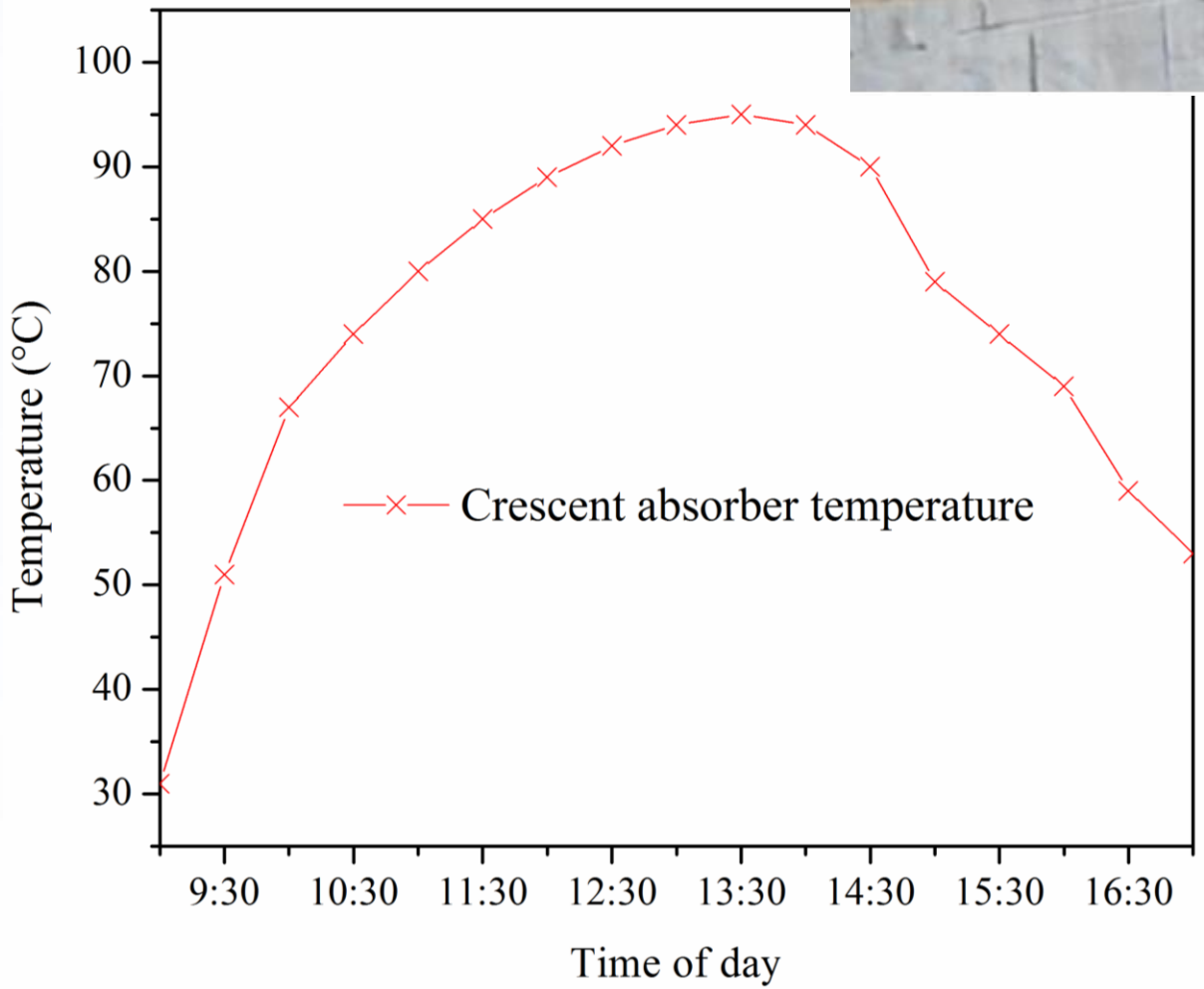


Fig. 3 Temperature of crescent moon shaped absorber

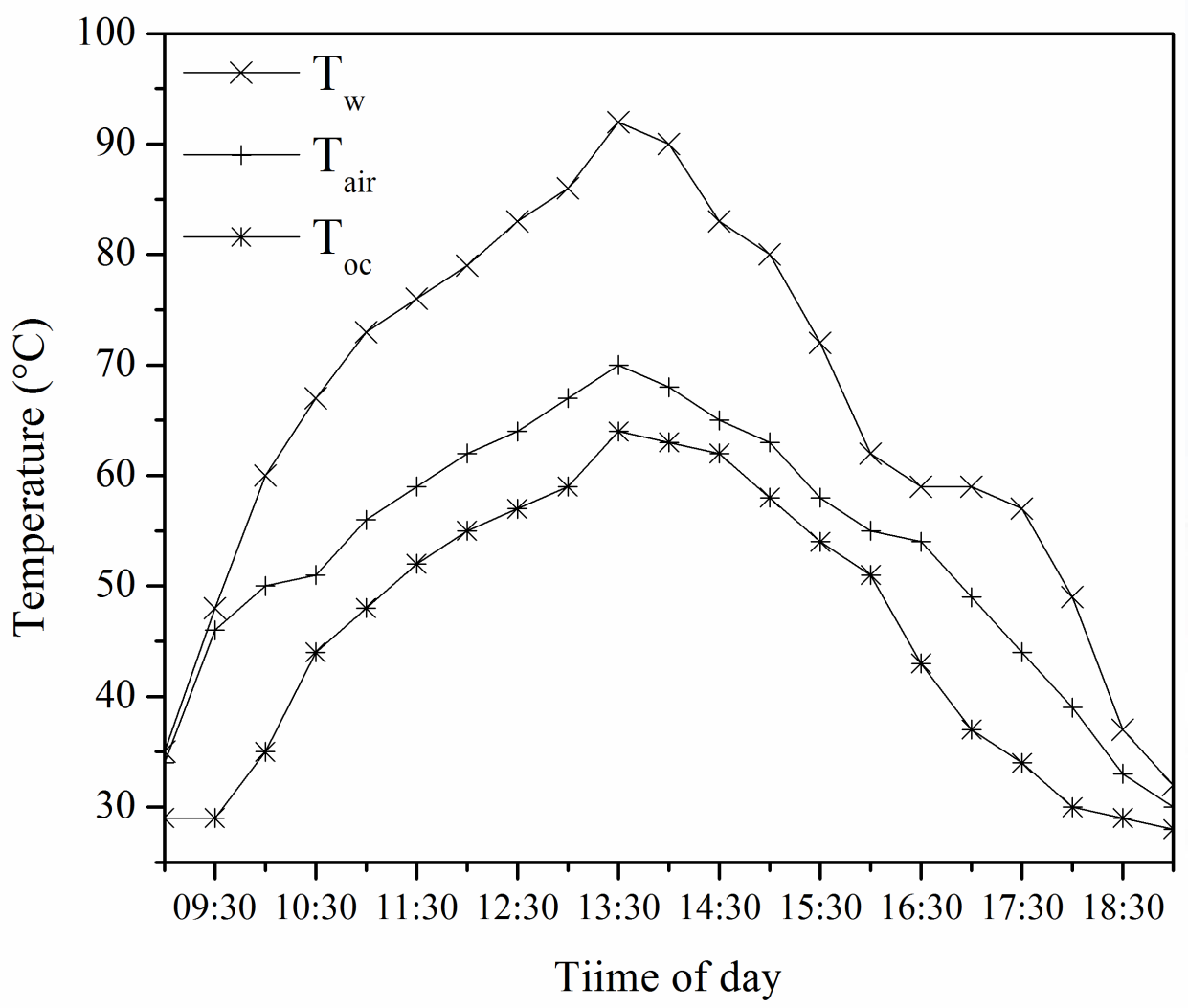


Fig. 4 CPC-CCTSS with PCM

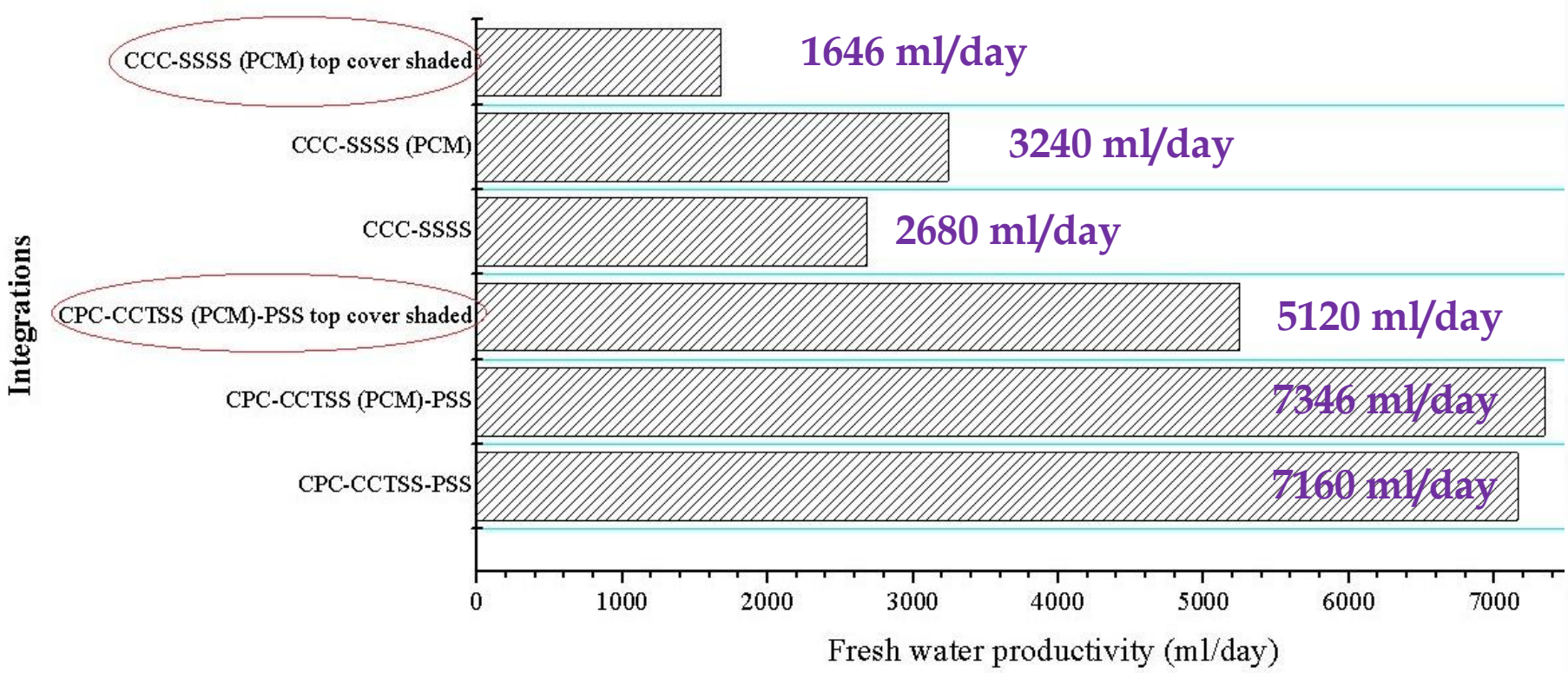


Fig. 5 Productivity with respect to time

CONCLUSION

In this work, concentrator powered, PCM integrated different solar desalinating systems are presented. Based on the experimental results, the following useful conclusions are arrived. The combination of concentrators and PCM enhanced the overall system performance.

1. Productivity

S.No.	Designs	Productivity (ml)
1	CCC-SSSS	2680 ml/day
2	CCC-SSSS with PCM	3240 ml/day
3	CCC-SSSS with PCM (Shaded)	1646 ml/day
4	CPC-CCTSS-PSS	7160 ml/day
5	CPC-CCTSS with PCM-PSS	7346 ml/day
6	CPC-CCTSS with PCM-PSS (Shaded)	5120 ml/day

CONCLUSION

- ✓ From the experimental evidence, it was found out that the productivity of the two distiller does not drop to zero even when the top covers are shaded.
- ✓ The concentrators are supplied the heat energy to enable continuous fresh water production.
- ✓ This study concludes that integration yields enhancement.

RECOMMENDATIONS

- ✓ The "best" desalination system should be economically reasonable.
- ✓ It should work and deliver suitable amounts of fresh water at the expected quantity, quality, and cost for the life of a project.

Water, is life's most basic need.

Thanks for your attention