International Journal of Interdisciplinary Innovative Research &Development (IJIIRD)
ISSN: 2456-236X
Vol. **06** Issue **02** | **2022**

Experimental Analysis of Solar Still by using copper as heat storage material Aluminium as a reflector and External Condensation

Santosh Tryambak Suryavanshi[1], Narendra N. Bhostekar[2]

[1]*M.E. student Department of Mechanical Engineering Department, Manjara Charitable Trust, Rajiv Gandhi Institute of Technology, Mumbai, Juhu-Versova Link Road, Versova, Andheri (w)*
[2] *Assistant professor of Mechanical Engineering Department, Manjara Charitable Trust, Rajiv Gandhi Institute of Technology, Mumbai, Juhu-Versova Link Road, Versova, Andheri (w)*

ABSTRACT

There are different types of solar still. Single basin solar still is one of the simple solar device used for converting available brackish, saline or waste water into potable or drinkable water. This device can be fabricated easily with locally available materials. The maintenance is also cheap and no skilled labor is required. This still can be a suitable solution to solve drinking water problem. Because of its low productivity it is not popularly used. Numbers of works are undertaken to improve the productivity of the still. In this work progresses in the works done on single basin passive types still to improve its productivity are reviewed. The orientation and inclination are optimized to receive maximum radiation and lower the condensation loss. Different materials are used in the basin along with water to improve the heat capacity, radiation absorption capacity and enhance the evaporation rate. Copper plate with black paint is used in the basin to improve absorption, storage and evaporation effects..

Keyword: *- Single basin solar still; Solar desalination; Passive solar still; Experimental Analysis with separate condensation; Review.*

1. INTRODUCTION

Distillation or Desalination has long been considered as the practical solution for the current and future demand of potable water or drinking water. Desalination process is used to reduce the Total Dissolved Solids (with TDS of 5000 p.p.m and above) to an acceptable level of TDS equal to 500 p.p.m. Different desalination technologies can be applied. Desalination of ground brackish water by solar powered systems, is a practical and promising technology for producing potable water in the regions which suffers from water scarcity especially in the remote arid areas [1]. The rapid population growth, along with the expected social and economic development will increase the demand for water in such a way that the future water reserve in Jordan will not meet such a demand. Jordan in particular will face sever shortage of fresh water [2,3].

By the year 2025, fresh water demand will grow 40% more than what is consuming now. This increasing demand for water puts enormous strain on the ground aquifer, which results in lowering water level and increasing salt content. For that purpose, we can be used solar energy to change salt water into fresh drinking water by solar distillation unit.

Solar distillation has been used to provide fresh drinking water in locations. Quality of water is poor, Fresh water supply is inadequate or there is deficiency of fresh water treatment options are not available where the sunshine is abundantly available.

2. DESALINATION PROCESSES

2.1 Phase-change processes

- Multi-stage flash (MSF)
- Multiple effect boiling (MEB)
- Vapour compression (VC)
- Freezing
- Humidification/ dehumidification
- Solar stills
    - Conventional stills
    - Special stills
    - Cascaded type solar stills
    - Wick-type stills
    - Multiple-wick-type stills

2.2 Membrane processes

- Reverse osmosis (RO)
    - RO without energy recovery
    - RO with energy ecovery (ER-RO)
- Electrodialysis (ED)

3. OBJECTIVE

To connect the extra pipe on upper side of the basin in such a way that at outside of the basin to achieve maximum condensation. That means evaporation and condensation do separately to get maximum efficiency. The outside pipe with spiral shape can be used which is deep in water with proper insulation to get maximum yield.

In order to improve wetting area of the as well as conventional still basin, Cu sheet as a heat storing material and Cu reflector is used on walls of the basin on inner side.

Experimentally results of modified still have to compare with and without extra pipe i.e., External Condensation and with and without copper as a heat storage material.

Table No. 1: Material Selection

Part Name	Material	Size	Purpose of selection
Still basin	Acrylic	500*500 mm 4.5 mm thickness	Low thermal conductivity
Casing	Acrylic	4.5 mm thickness	Low thermal conductivity
Top cover	Glass	508 x 540 mm. 5 mm thickness	High transmittivity
Heat storage material	Copper sheet and aluminum Reflector	490 *460 mm. 5 mm thickness	High thermal conductivity and corrosion resistance
Water collector	Acrylic	(L-shaped) 4.5 mm thickness	Low thermal conductivity
Outside pipe	Copper	20 mm diameter	Corrosion resistance
Glass slope	32^0		Maximum radiation absorption

Table No. 2 Thermal Properties of Al and Cu.

Properties	Al	Cu
Melting Point (K)	933	1358
Density (kg/m^3)	2706	8933
Specific Heat ((j/ kg.k)	903	385
Thermal Conductivity (W/ m.k)	237	401

4. LITERATURE REVIEW

Ayush Kaushal, 2010, Renewable and Sustainable Energy Reviews: To overcome unavailabilty problem of drinking water there is a need for some sustainable source for the water distillation (purification). A proper combination of cooling film parameters enhanced the still efficiency by 20%. In multi-effect diffusion model the productivity decreases about 15% with an increase in diffusion gaps between partitions from 5 mm to 10 mm.

Muafag Suleiman K.Tarawneh, 2007, Effect of Water Depth on the Performance Evaluation of Solar Still: The possibility of increasing the water productivity could be reached by lowering the water depths on the basin-absorbing plate. It is necessary to investigate the effect of all the operational parameters before taking the decision of installing the solar distillation plant.

K. Kalidasa Murugavel a, Kn.K.S.K. Chockalingam a, K. Srithar,2008, Progresses in improving the effectiveness of the single basin passive solar still: Rubber is the best basin material to improve absorption, storage and evaporation effects.Mica sheet as suspended absorber is better material for surface heating

Hrushikesh Kulkarni 1 Chinmay Kute 2, Chirag Patel 3 Akshay Tavse 4 Prof. Lokesh R.5 Dhumne Experimental Investigation and Performance Evaluation Osolar Still Using Phase Change Material (2018): The Solar still equipped with phase change material (PCM) is to be design and fabricated to improve the daily yield and efficiency of the still. Also, the effect of various parameters such as glass cover inclination, flow rate, Material thermal conductivity is to be study. Stepped solar still efficiency is better as compare to the conventional solar still.

5. EXPERIMENTAL PROCEDURE

- First an observation table is prepared for noting down the readings. The table consists of following columns: Time (in Hr), Basin Water Temp. (BWT) (in °C), Productivity (in ml).
- The experimental hours are from 9 am to 5 pm. (8 hours)
- The solar still is placed where the sunlight is radiant properly making sure that no part of the still is under shadow of external objects during the experimental hours.
- All the clamps are checked to make sure that glass plate is resting properly on still without any gaps.
- The glass plate is cleaned with a dry cloth to remove any dirt or dust accumulated.
- The supply tank placed at a height is filled with saline water and at an appropriate flow rate the saline water is allowed to flow through the pipe into the tank.
- Now at an interval of an hour the readings are taken accordingly.
- The temperatures are measured using the digital thermometers installed in the still and productivity is measured in terms of distilled water collected in m

5.1 Observation Table

Table no 3: Observation table for various reading

Sr. No.	Time	Without Modification		With Modification	
		Productivity(ml)	Water Temp (^{0}C)	Productivity (ml)	Water Temp (^{0}C)
1	9:00 AM	5	20	5	22
2	10:00 AM	14	35	18	32.3
3	11:00 AM	20	45	28	45.3
4	12:00 PM	30	61.2	76	60.1
5	1:00 PM	86	72.4	105	75
6	2:00 PM	80	70.3	147	87.4
7	3:00 PM	78	65.8	190	89.2
8	4:00 PM	75	60.1	130	73.9
9	5:00 PM	38	55.1	70	55.2

6. RESULTS AND CONCLUSION

Heat is the basic from of energy transformation. In every process heat plays significant role. Loss of heat and gain of heat can change the performance of the system accordingly. Sometime it helps to improve performance whereas sometimes it leads to failure of the system or reduce the performance. More importantly it can be noted that this performance is directly affects energy consumptions. Copper helps to control this heat within required conditions and hence results in better improvement in the performance of the system. Efficiency should be increases because of separate evaporation and condensation is to be done. Cost effective model and light weight. Study and

analyses the model according with design parameters. Results should be comparative with and without outside pipe and copper sheet and copper reflector as a heat storing material. Result can be summarize using the graphs shown below.

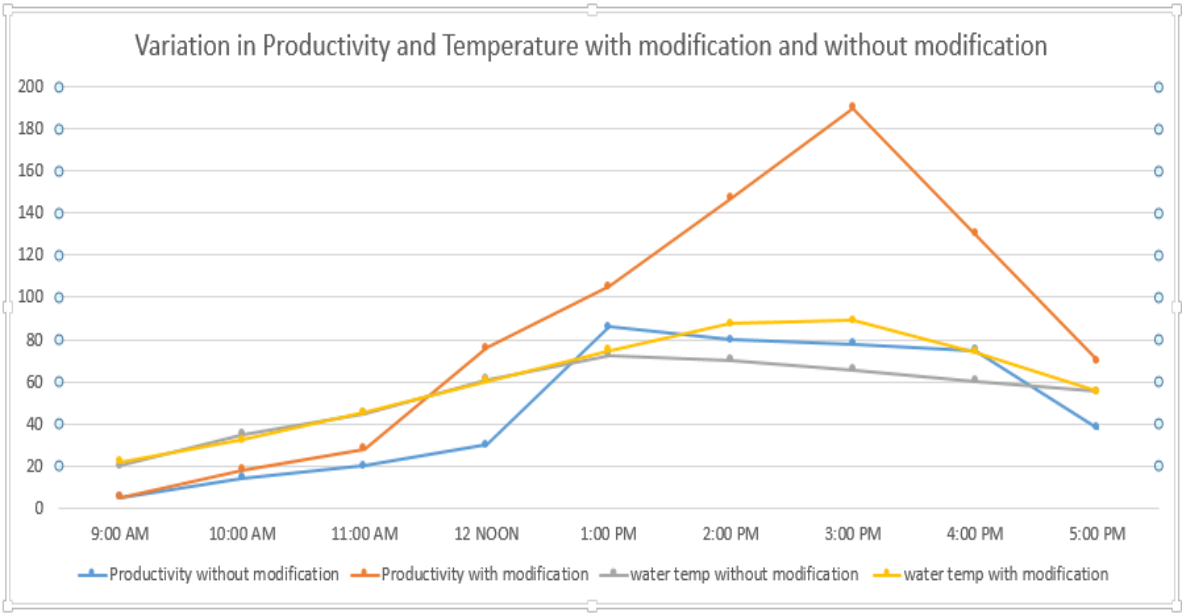

Fig 1: Variation in Productivity and Temperature with modification and without modification

7. REFERENCES

[1] Muafag Suleiman K. Tarawneh,2007, Effect of Water Depth on the Performance Evaluation of Solar Still
[2] K. Kalidasa Murugavela, Kn.K.S.K. Chockalingama, K. Srithar,2008, Progresses in improving the effectiveness of the single basin passive solar still.
[3] B.B. Sahooba, N. Sahooab, P. Mahantab, L. Borbora a P. Kalita
[4] Tiwari GN. Solar energy: fundamentals, design, modeling and application. New York/New Delhi: CRC Press/Narosa Publishing House; 2003.
[5] Environmental management and sustainable development Mattheus F. A. Goosen(2012)
[6] Hrushikesh Kulkarni 1 Chinmay Kute 2, Chirag Patel 3 Akshay Tavse 4 Prof. Lokesh R. 5 Dhumne EXPERIMENTAL INVESTIGATION AND PERFORMANCE EVALUATION OF SOLAR STILL USING PHASE CHANGE MATERIAL(2018)
[7] Duffle JA, Beckman WA. Solar engineering of thermal process. New York, USA: Wiley; 1991.
[8] National Research Council of the National Academies. Fluoride in drinking water: a scientific review of EPA's standards.
[9] Abdel-Rehim ZS, Lasheen A. Improving the performance of solardesalination systems. Renew Energy 2005;30:1955–71.
[10] M.A.S. Malik, G.N. Tiwar, A. Kumar and M.S. Sodha, Solar Distillation, Pergamon Press, UK, 1982.
[11] G.R. Lashkaripour, M. Zivadar, Desalination of brackish water in Zahedan city in Iran, Desalination Vol177.2005,1-5.