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Fabrication of Double Slope Solar Distillation System

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ABSTRACT
There is almost no water left on earth that is safe to drink without purification after 20-25 years from today. This is a seemingly bold statement, but it is unfortunately true. Only 1% of Earth's water is in a fresh, liquid state, and nearly all of this is polluted by both diseases and toxic chemicals. For this reason, purification of water supplies is extremely important. Keeping these things in mind, we have devised a model which will convert the dirty/saline water into pure/potable water using the renewable source of energy (i.e. solar energy). The basic modes of the heat transfer involved are radiation, convection and conduction. The results are obtained by evaporation of the dirty/saline water and fetching it out as pure/drinkable water.Its application was proven to be most economical, as most systems in individual uses requires. This paper reviews the present day solar thermal technologies. Performance analyses of existing designs (study),and fabrication of double slope solar distillation system have been discussed in this paper.

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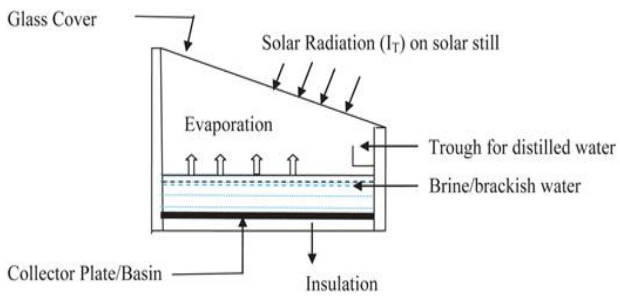
I. INTRODUCTION

The sun radiates the energy uniformly in all direction in the form of electromagnetic waves. When absorbed by body, it increases its temperature. It is a clean, inexhaustible, abundantly and universally available renewable energy.

At the bottom side of the basin, 38 copper tubes of 1.5cm outer diameter were carefully arranged and submerged under three litter of tap water. Depending on the desired R-value, some of the tubes were filled with PCM and the remaining tubes were left empty. In each experiments, all the 38 tubes were always used and the only thing changes is the number of PCM filled tubes to investigate the effect of the amount of PCM on the water productivity. The PCM capacity of each tube is 40 g and the PCM filled tubes were tightly sealed to prevent water from leaking in or PCM from leaking out of the tubes. All tubes were painted with a black colour to maximize the solar irradiation absorption.



Experimental procedure

The experiments were carried out from April to August 2018 in Muscat-Oman. Each set of experiment was conducted within four consecutive days for the four desired values of the parameter R (0, 0.17, 0.35 and 0.51) which is defined as Mass of PCM Mass of Water. The experiments typically start from 8:30 a.m. until the next day 7:30 a.m. The collected water (condensate) was recorded every one hour until 12:00 a.m. and the accumulated water produced after 12 a.m. is recorded the next day morning. After each experiment, the pH and conductivity of the collected water were measured and recorded and the recorded temperatures data (basin water, ambient, PCM, and vapor) were extracted from the temperature recorder and analysed using excel. Table

1 shows the number of PCM filled tubes, mass of PCM and the value of R for eachs et of four experiments. The mass of the water is constant and equals 3kg and its electrical conductivity is 869.6 μS/cm.

Experimental Set-up

The photograph of double slope active solar still under study have been shown in fig.2. In active solar still, the flat plate collector is integrated with double slope active solar still in such a way that the hot water from collector plate enters into the basin of solar still under forced circulation mode. The inlet and outlet connections to the collector plate are taken from the bottom of the basin as shown in Figure 1a. A gate valve has been provided in the inlet pipe to control the circulation of water through the collector plate. The collector plate absorbs the solar energy and transfers that energy to water flowing through tubes. The double slope solar still placed in east-west direction and collector plate was inclined at 30o facing south to

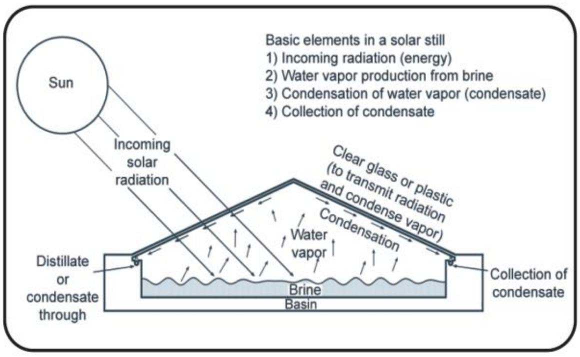


Table 5.2.1. Observation under Normal mode Drying

Day 1

Temp/Time	9am	10am	11am	12am	14pm	15pm	16pm
(Ambient)T_1	31	32	34	36	35	31	30
(Inlet) T_2	31	32	34	36	35	31	30
(Bed) T_3	32	33	35	37	36	31	31
(outlet) T_4	30	31	33	35	34	30	30
M(kg)							
chilli	1 kg						0.75

Chilli, Intial Weight = 1 kg
Final weight = 0.75 kg
Moisture Removed = 0.25kg

Day 2

Temp/Time	9am	10am	11am	12am	13pm
(Ambient)T_1	30	33	34	35	37
(Inlet) T_2	30	33	34	35	37
(Bed) T_3	31	34	35	36	38
(outlet) T_4	30	32	33	34	36
M(kg)					
chilli	0.75kg				

Chilli, Intial Weight = 1 kg
Final weight = 0.55 kg
Moisture Removed = 0.45kg

Day 3

Temp/Time	9am	10am	11am	12am
(Ambient)T_1	31	32	35	37
(Inlet) T_2	31	32	35	37
(Bed) T_3	32	33	37	37
(outlet) T_4	30	31	33	35
M(kg)				
chilli	0.55kg			

Chilli Intial Weight = 1 kg
Final weight = 0.33 kg
Moisture Removed = 0.67kg

Drier Efficiency Evaluation

Mode	**Sample weight, m_g (kg)**	**Moisture Evaporated m_w (kg)**	**Avg. Temp. Inlet(T_2) ^{o}c**	**Avg. Temp. outlet(T_4) ^{o}c**	**Avg. solar Insolation, (I) w/m^2**	**Avg. sunshine hours, (t_d)**
Normal	1	0.67	34	33	800	6
Dual	1	0.66	35	31	750	6

Variation of Drier Bed Temperatures (T_3) vs Drying Time

The following graph shows the variation of temperature **,**T_3 inside the drying cabinet and ambient temperature with Drying time in Normal and Dual modes. Increasing the temperature inside the cabinet will enhance drying rate and efficiency

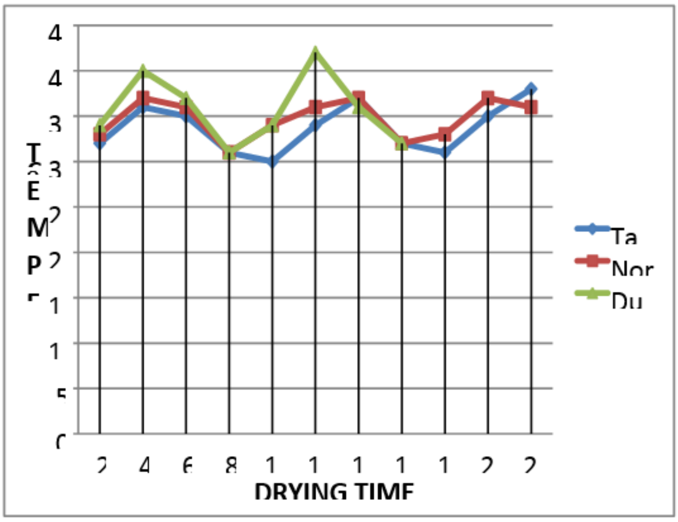


Figure 5.4.1 Drier Bed Temperature vs Dying Time

II. CONCLUSION

- ❖ The efficiency of the dual mode drying (η_{dth}= 21.1%) gets increased compared to normal mode drying (η_{dth}=19.6%)
- ❖ The Drying time for the same quantity of grain(chilli) as found decreased from 22hrs to 16hrs.

REFERENCES

[1]. Mohanraj, M.; and Chandrasekar, P. (2008). Comparison of drying characteristics and quality of copra obtained in a forced convection solar drier and sun drying. Journal of Scientific and Industrial Research, 67(5), 381-385.

[2]. Shanmugam, V.; and Natarajan, E. (2007). Experimental study of regenerative desiccant integrated solar dryer with and without reflective mirror. Applied Thermal Engineering, 27(8-9), 1543-1551.

[3]. Performance of a forced convection solar Drier integrated with gravel as heat storage Material for chili drying, M. Mohanraj1,*, p. Chandrasekar2 journal of engineering science and technology,Vol. 4, no. 3 (2009) 305 – 314

[4]. Holman J.P. (2007). Experimental methods for engineers (7th Ed.). New Delhi: Tata Mcgraw hill Publishing Company.

[5]. Performance Evaluation of a Mixed-Mode Solar Dryer, Bukola O. Bolaji and Ayoola P. Olalusi*, Department of Mechanical Engineering, University of Agriculture Abeokuta, Ogun State, Nigeria AU J.T. 11(4): 225-231 (Apr. 2008)

[6]. An Analytical Study on Production and Export of Fresh and Dry Fruits in Jammu and Kashmir, Naseer Ahmad Rather*, Parvaze Ahmad Lone*, Ajaz Ahmad Reshi**, Muzafar Manzoor Mir** , International Journal of Scientific and Research Publications, Volume 3, Issue 2, February 2013 1 ISSN 2250-3153

[7]. A greenhouse type solar dryer for small-scale dried food industries: Development and dissemination Serm Janjai, www.IJEE.IEEFoundation.org ISSN 2076-2895 (Print), ISSN 2076-2909 (Online) ©2012 International Energy & Environment Foundation. All rights reserved.

[8]. Experimental studies on a hybrid dryer Gauhar a. Mastekbayeva, chandika p. Bhatta, m. Augustus leon and s. Kumar energy program, asian institute of technology, p.o. box 4, klong luang, pathumthani 12120, Thailand

[9]. Databank_110614.pdf By Govt. of India in coordination with CIPHET,CSO,NAS,NSA,NSSO,DIPP,DGCI&S

[10]. Design and performance of a solar air heater with long term heat storage Abhishek Saxena a,⇑, Nitin Agarwal a,1, Ghansyham Srivastava b International Journal of Heat and Mass Transfer

[11]. Drying Kinetics of Muscat Grapes in a Solar Drier with Evacuated Tube Collector, AR. Umayal Sundari*a, P. Neelamegamb, C.V. Subramanianc w www.ije.ir, Vol. 27, No. 5, (May 2014) 811-818

[12]. Solar drying: fundamentals, Applications and innovations Editors: ching lik hii, sachin vinayak jangam, sze pheng ong And arun sadashiv mujumdar – 2012

[13]. Performance Study of a Solar Integrated Central Heating System of a Residential Building using TRNSYS-An Hourly Simulation Model, M. Ahmadzadehtalatapeh* International Journal of Engineering

[14]. Design, Construction and Testing of Solar Dryer with Roughened Surface Solar Air Heater Sandeep Panchal#1, Satish Kumar solanki#1, Sunil Yadav#1, Prof Asim Kumar Tilkar#1, Prof Ravi Nagaich#2#1 Mahakal Institute of Technology, Ujjain (M.P.) 456010 #2 Ujjain Engineering College, Ujjain (M.P) 456010 International Journal of Innovative Research in Engineering & Science ISSN 2319-5665 (July 2013, issue 2 volume 7)

[15]. Design and Evaluation of Solar Grain Dryer with a Back-up Heater K.S. Tonui, E.B.K. Mutai, D.A. Mutuli, D.O. Mbuge and K.V. Too, Research Journal of Applied Sciences, Engineering and Technology 7(15): 3036-3043, 2014 ISSN: 2040-7459; e-ISSN: 2040-7467 © Maxwell Scientific Organization, 2014

[16]. Performance evaluation of a PV powered solar dryer By Akil Ahammed#1, Mohammad Tawheed Kibria#2, Md. Sayeed-Ur-Rahim Mahadi#3, Nasif Shams#4, Saiful Huque#5# Institute of Renewable Energy, University of Dhaka,Dhaka-1000, Bangladesh