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Analysis Effects of Average Value of Convective and Evaporative Heat Transfer Coefficient on Solar Cabinet Dryer for Reduction of Mass of Papad

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Abstract: In this research paper, the behavior of heat and mass transfer phenomenon during greenhouse papad drying under forced convection mode has been investigated. Various experiments were performed during the month of April 2020 at SRCEM Banmore, morena (26°34'13" N 78°10'48" E). Experimental data obtained for forced convection greenhouse drying of papad were used to determine the constants in the Nusselt number expression by using the simple linear regression analysis and, consequently, the values of convective and evaporative heat transfer coefficients were evaluated. The average values of experimental constants C and n were determined as 0.9714 and 0.0129 respectively. The average values of convective and evaporative heat transfer coefficients were determined as 0.0886 W/m^2 °C and 6.7583 W/m^2 °C respectively. The experimental error in terms of percentage uncertainty was also evaluated.

Keywords: Papad, Papad drying, Heat transfer coefficient, Convective, Evaporative, Forced convection greenhouse

I. INTRODUCTION

Most Indian households consume papad, which is one of the most common diet adjuncts. India is the world's largest papad producer, with domestic or cottage size production accounting for about 95% of total production. It is made with a dough made up of several pulses and flours, as well as other ingredients. It's made by rolling dough balls with low moisture content (27 percent to 30 percent) into circular discs (130 mm to 210 mm diameter) with thicknesses ranging from 0.4 to 0.7 mm.

Papad drying is a simultaneous heat and mass transfer process in which heat is transported to the papad-air interface via convection and radiation, and then to the interior of the papad via conduction. Diffusion transports water from inside the papad to the papad-air contact, while convection transports water from the interface to the air stream. As a result, papad drying entails the removal of moisture in order to preserve the papad. Sunlight based drying of food is a compelling methods for food safeguarding and is particularly valuable in creating regions where fuel assets are scant. Food drying jelly food by easing back down the activity of proteins, microbes, yeasts, and molds [1]. Sunlight based drying has been utilized since ancient occasions to dry food varieties like vegetables, organic products, fish, and meat just as different things like creature skins and soil blocks to assemble homes [1]. Regular drying strategies were created around the eighteenth century are as yet used in industry today [1]. Today, crop drying is predominantly done at mechanical levels in huge food driers for mass business sectors. Normal dried food things incorporate oat grains, natural products, and grapes. Drying can likewise assist with forestalling waste by drying the pieces of the plant tossed out during cooking and transforming them into creature feed [2].

II. DRYER CLASSIFICATION

Fundamental drying material science is something similar for a wide range of dryers, traditional or sunlight based. Figure 1 is a schematic appearance a normal breakdown of dryer order.

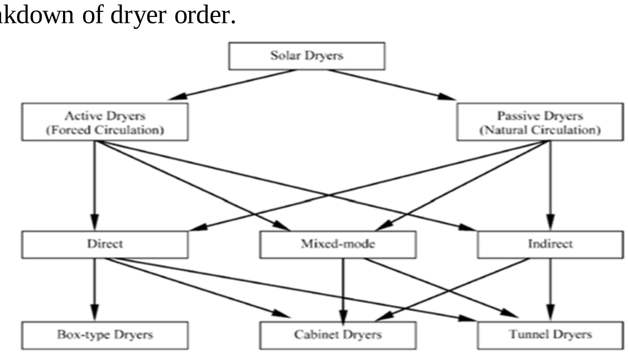
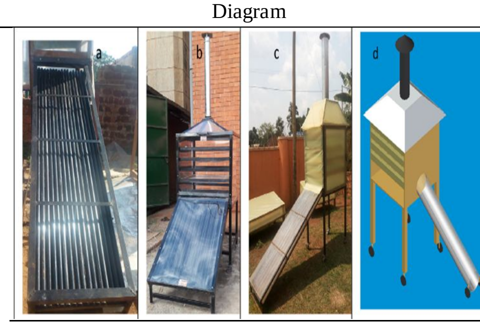


Figure 1: Dryer Classification

Sorts of ordinary dryers, those that utilization power or fuel to control radiators and fans, incorporate both high temperature, quick drying strategies and low temperature, mass stockpiling techniques. High temperature dryers need controls to screen the circumstance and temperature, since temperatures can without much of a stretch over dry items whenever left in touch with the food until the harmony dampness content is reached [5]. Additionally, if high temperatures are utilized too soon in the drying cycle, a few food varieties will solidify/cook outwardly and trap the excess dampness within [6]. Low temperature techniques are utilized for mass stockpiling, regularly with grains, and when the shading and certain supplements should be saved in the food. [5] Sun powered drying can be separated into three sub classes: open (or regular), dynamic, and inactive. Open drying includes presenting the yield to the indigenous habitat and sun openness with no cover or security from the components. Open drying should be possible on the branch (like grapes) or after reap on open ground, mats, or concrete. This is an extremely normal technique for drying in tropical regions [7]. As per Murthy, 80% of food created by little ranchers in creating nations is dried by open sun drying [8].

III. SUMMARY

S No	Name of Author	Title	Work Summary	Diagram
01	Ssemwanga Mohammed Nakiguli Fatumah Nasejje Shadia	Drying performance and economic analysis of novel hybrid passive mode and active-mode solar dryers for drying fruits in East Africa	This study evaluated the drying performance of the ISD and SPE dryers and compared against that of the traditional OSD method. Results show that the drying performance of the ISD and SPE dryers was better than that of the traditional OSD method. The SPE and ISD dryers took 10 and 18 h to effectively dry the fruit products.	
02	Masnaji R.Nukulwar Vinod B.Tungikar	A review on performance evaluation of solar dryer and its material for drying agricultural products	This paper gives an idea about the recent development in solar dryers. Some solar dryers are equipped with thermal storage to enhance the efficiency and drying rate in off-sunshine hours. To overcome the sunshine irregularity, some solar dryers have come up with solar thermal reservoirs. A comprehensive review on different dryers according to the product has been carried out, which helps in development and redesign of the solar dryer. From this paper, an idea regarding products drying likes chili, turmeric, peanut, grapes, copra and fish are presented. Which type of dryer is suitable and what kind of improvement could be possible in the future is obtained.	 

<table>
<tr>
<td>03</td>
<td>Promise Joseph Etim
Akachukwu Ben Eke
Kayode Joshua Simonyan b</td>
<td>Design and development of an active indirect solar dryer for cooking banana</td>
<td>Active indirect mode solar dryers were designed and constructed for drying of cooking banana in Umudike, Nigeria. The dryers were constructed with special focus on the air inlet, to examine if the air inlet area had effect on the performance of the dryers. The air inlet areas were considered in five levels and four shapes namely: square, rectangular, circular and triangular. A total of 52 dryers were required for the experiment, based on the combination of factors and levels of experiment using the Central Composite Rotatable Experimental Design adopted for the study. Fresh samples of cooking banana were obtained from a local market, peeled, cleaned and sliced to the desired thickness for the drying experiment. Open sun drying was used a control.</td>
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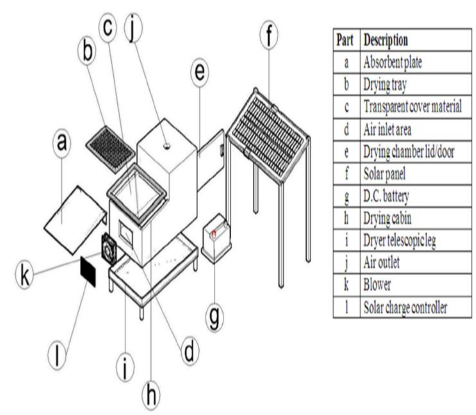

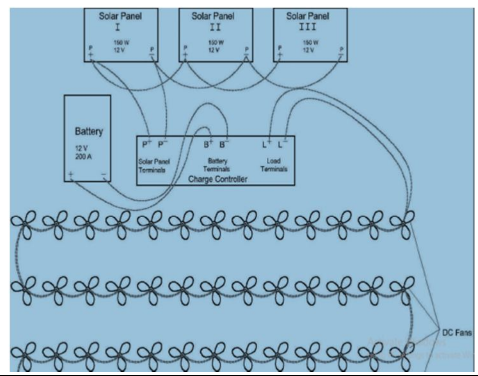

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<td>04</td>
<td>Anan Ashrabi Ananno, Mahadi Hasan Masud, Peter Dabnichkia, Asif Ahmedb</td>
<td>Design and numerical analysis of a hybrid geothermal PCM flat plate solar collector dryer for developing countries</td>
<td>This work presents a detailed design and comprehensive numerical analysis of a hybrid geothermal-PCM flat plate solar collector, which is in effect a self-sustaining renewable energy food drying system. The applicability of the hybrid geothermal-solar dryer for developing countries with a significant underground geothermal temperature gradient is investigated. The performed numerical analysis promises high efficiency and effectively of this near-zero hybrid energy technology. The proposed conceptual design assessed using the related mathematical model to assess the functional parameters of the hybrid geothermal PCM flat plate solar collector dryer.</td>
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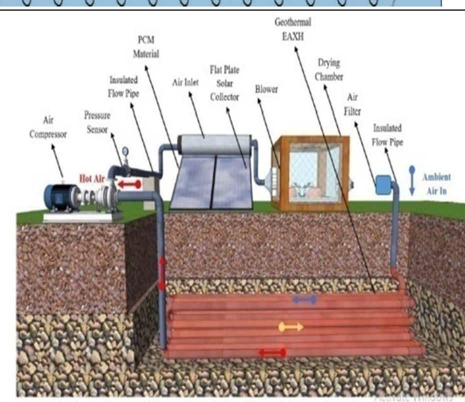

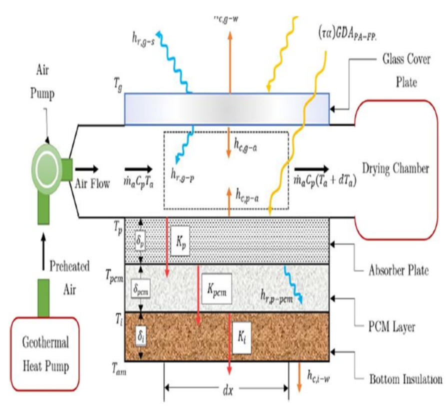

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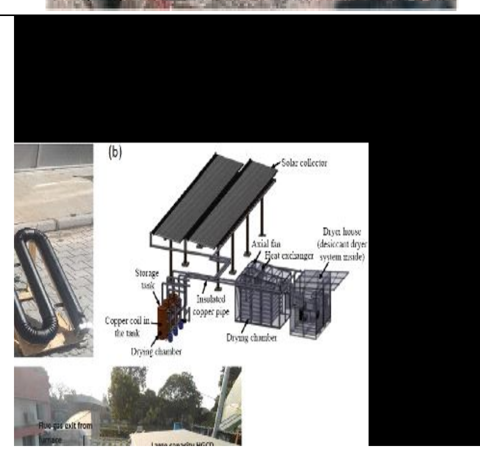
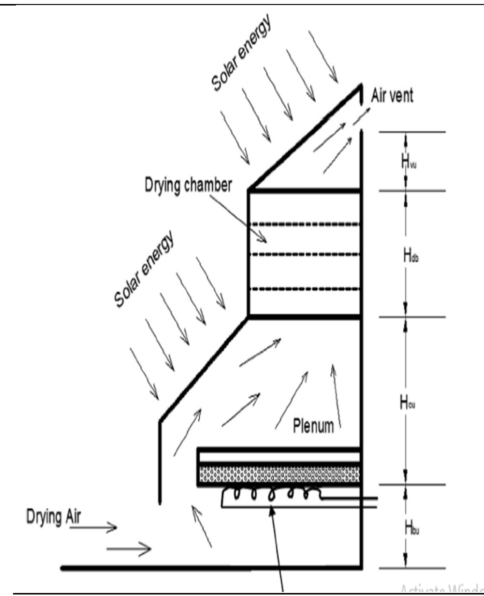
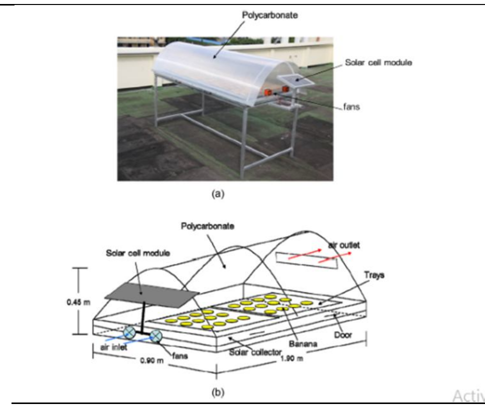
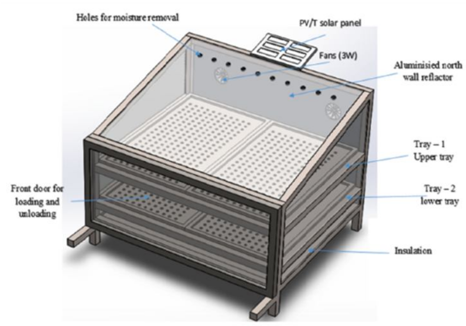
05	Roonak Daghigh Roonak Shahidian, Hooman Oramipoor	A multistate investigation of a solar dryer coupled with photovoltaic thermal collector and evacuated tube collector	In this study, an indirect solar dryer was designed and manufactured using a Photovoltaic Thermal (PV/T) collector and Evacuated Tube (ET) collector. The main objectives of this system were to supply the thermal load of the indirect solar dryer, to find the best model for the drying process, to present a new model to predict the drying process of Tarkhineh (the drying material) and to perform its life-cycle cost analysis (LCCA). The manufactured system was tested under the weather conditions of Sanandaj city, Iran and was compared with open sun drying.	
06	Pooja Dutta Partha Pratim Dutta Paragmoni Kalita	Thermal performance studies for drying of Garcinia pedunculata in a free convection corrugated type of solar dryer	The present work focuses on drying of Garcinia pedunculata in an efficiently developed free convection corrugated solar dryer (FCCSD) and conventional open sun. The experimental solar drying results for two batches are presented. The moisture contents of Garcinia pedunculata in the dryer was reduced to 7.22% (wb) for the first batch and 7.1% (wb) for the second batch in 28 h from the initial of 88% (wb) of moisture content. Moisture content was reduced to 10.18% (wb) and 10.08% (wb) for the first and second batches respectively in 55 h in open sun drying	
07	Y. Mohana R. Mohanapriya T. Anukiruthika K.S. Yoha, J.A. Moses C.Anandharamakrishnan	Solar dryers for food applications: Concepts, designs, and recent advances	This review provides valuable insights into the state of the art of solar dryers, to assist the progress of this green and sustainable technology for food applications. Advanced studies on photovoltaics, thermal storage systems, low-cost durable and efficient solar collectors and auxiliary renewable energy sources integrated with conventional solar drying systems;	

08	C.K.K. Sekyere F.W. Adams F. Davis F.K. Forson	Mathematical modelling and validation of the thermal buoyancy characteristics of a mixed mode natural convection solar crop dryer with back up heater	This paper presents the modelling and subsequent validation of the thermal buoyancy characteristics for an experimental mixed-mode natural convection solar crop dryer (MNC- SCDBH) for three plenum inlet opening to vent outlet opening ratios of 1:1, 1:1.3 and 1:1.5 selected for the purpose of this study. The simulation follows the authors' experimental study on the effect of varying the plenum inlet width and vent outlet width on thermal buoyancy performance of the MNCSCDBH for three different heating scenarios namely; so- lar heating, back up heating and hybrid heating. Mathematical models, capable of predict- ing the thermal buoyancy performance of the MNCSCDBH for the three selected heating modes were formulated by coupling energy balance equations on the components of the air-heater with energy balance for the air.	
09	V.P. Sethi⁎, Mankaran Dhiman	Design, space optimization and modelling of solar-cum-biomass hybrid greenhouse crop dryer using flue gas heat transfer pipe network	A solar-cum-biomass hybrid greenhouse crop dryer (HGCD) is presented to work on solar energy and on biomass heat for 24 h continuous operation at constant drying temperature of 62 °C. Vertical gap (clearance) between two consecutive trays is optimized for selected latitudes of 30°, 35°, 40°, 45° and 50°N. Global solar radiation and thermal models are developed to predict the solar radiation availability and HGCD chamber air temperature (Thgcd). Forced draft paddy straw bale combustor (FDPSBC) is used to generate flue gas above 500 °C temperature as supplemental heat source and coupled with flue gas heat transfer pipe network (FGHTPN) laid inside the HGCD to maintain Thgcd at constant temperature. Biomass heating load requirements (forced convection and radiation heats) were predicted through developed heat transfer model	

10	S. Nabnean P. Nimnuan	Experimental performance of direct forced convection household solar dryer for drying banana	In this study, the performance of direct forced convection household solar dryer for drying banana is presented. A solar dryer with a polycarbonate plates cover on a flat plate collector was constructed and it was designed in the parabolic shape. A polycarbonate cover is used to reduce heat losses while allowing the incident solar radiation to transmit into the dryer. Five batches of banana were dried in this solar dryer during January–July 2019. For each batch, 10 kg of bananas were dried.	
11	D. Jagadeesh M.VivekanandanA. Natarajan S. Chandrasekar	Experimental conditions to identify the ideal shape of dryer investigation of six shapes of solar greenhouse dryer in no load	Solar energy plays a vital role in improving the shelf of the agricultural product through drying, solar greenhouse drying is more optimal than using an open air drying, in this study selecting a ideal shape of greenhouse dryer among the other shapes is investigated. Six shapes of solar greenhouse dryers are designed in such a way that each dryer maintains the same volume of 30 ft3. The six shapes are Parabola, Quonset, Modified Quonset, Pyramid, Igloo and tropical. The inside temperature of greenhouse dryer is in the following order from maximum to minimum, Quonset, Tropical, Pyramid, Parabola, Modified Quonset and igloo during summer season	
12	Saloni Spall V.P. Sethi	Design, modeling and analysis of efficient multi-rack tray solar cabinet dryer coupled with north wall reflector	An innovative design of front loaded multi-rack tray (MRT) solar cabinet dryer is presented having optimally inclined reflective north wall (RNW) which utilizes reflected component of the solar radiation in addition to the beam radiation for efficient drying particularly in winter when conventional dryer does not perform well at higher latitudes (>30◦N). A modified global solar radiation capture model coupled with RNW is presented to determine the effect of RNW on its performance. A thermal model is also developed for chamber air temperature (Tch) and crop surface temperature (Tc) with experimental validation and solved using Modified Euler's method using FREEMAT software with experimental validation at Ludhiana climate (30.56◦N) India.	

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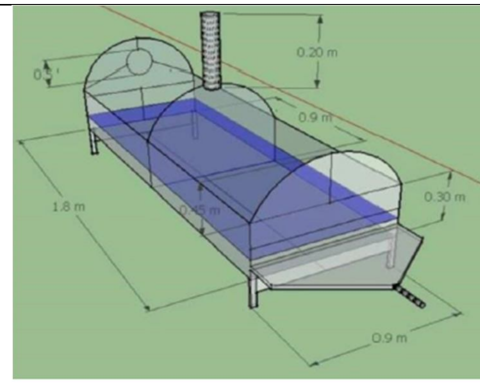
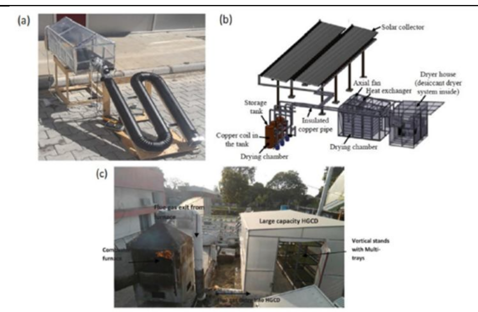
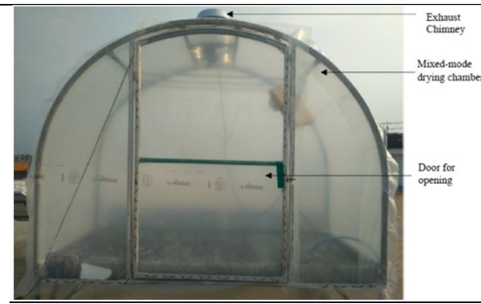
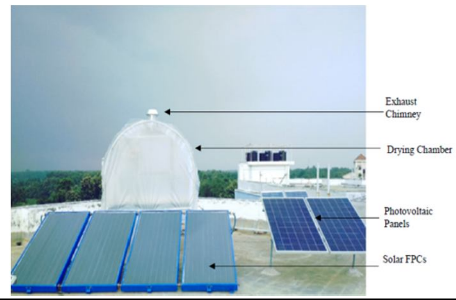
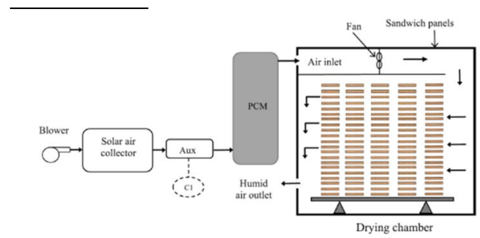
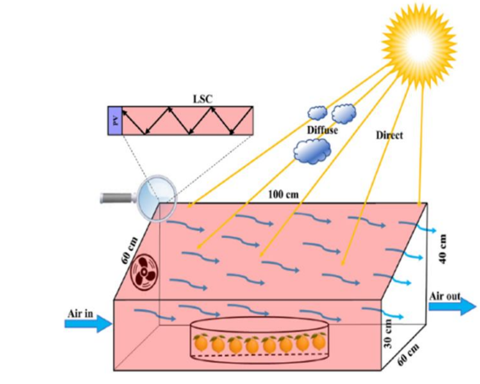
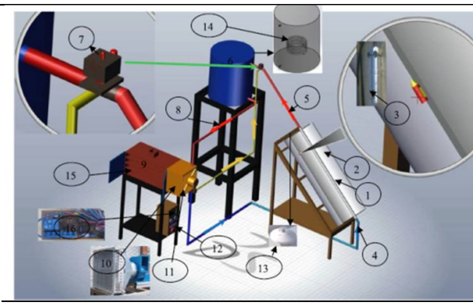
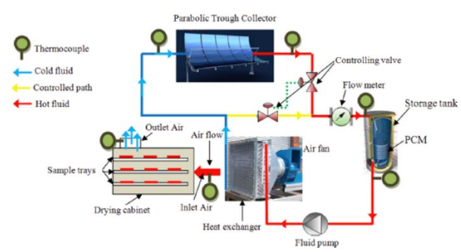
13	Nitin Ralph Pochont Mohammad Noor Mohammad Bodepu Thrinadh Pradeep P. Vijaya Kumar	A comparative study of drying kinetics and quality of Indian red chilli in solar hybrid greenhouse drying and open sun drying	This work reports efficient drying behavior of Indian red chilli dried in controlled greenhouse dryer under solar radiation in tropical summer conditions. A comparative study has been carried out on drying kinetics, the quality of red chilli in solar hybrid greenhouse dryer and open sun. Desirable moisture content (%) was achieved with rapid drying rate in active drying (18.67% in 9 h) compared to passive drying (24.24% in 12 h) and open sun (24.24% in 24 h) drying conditions.	
14	Nidhul Kottayat, Sachin Kumar, Ajay Kumar Yadav S. Anish	Computational and experimental studies on the development of an energy-efficient drier using ribbed triangular duct solar air heater	Triangular duct cross-section is introduced for solar air heater (SAH) of an indirect type of solar dryer (ITSD). Using computational study, the thermo-hydraulic performance of triangular duct SAH with inclined ribs for varying rib inclination ($30^\circ < \alpha < 75^\circ$) in the turbulent flow regime ($5000 < Re < 17500$) is studied. With the rib configuration providing maximum thermos-hydraulic performance, a ribbed rectangular duct SAH is designed, and the performance of the same is compared to the former for similar heat input. Results show that the ribbed ($\alpha = 45^\circ$) triangular duct has 17% higher effectiveness compared to the latter and 79% when compared to smooth SAH. Ribs in triangular duct solar air heater facilitate the increase in temperature even in the core of the duct, delivering the air at 6 K additional temperature relative to a rectangular ribbed duct for same heat input and flow *Re*.	
15	Y. Mohana R. Mohanapriya T. Anukiruthika K.S. Yoha J.A. Moses C.Anandharamakrishnan,	Solar dryers for food applications: Concepts, designs, and recent advances	Besides, various recent advancements, challenges, and limitations for implementing large-scale solar drying of foods are presented in terms of technology, energy considerations, and other socio-economic aspects. Thus, this review provides valuable insights into the state of the art of solar dryers, to assist the progress of this green and sustainable technology for food applications.	

16	Jigar K. Andharia Paritosh Bhattacharya Subarna Maiti	Development and performance analysis of a mixed mode solar thermal dryer for drying of natural rubber sheets in the north-eastern part of India	In this study, a 6 kg/batch mixed-mode solar thermal dryer was developed and installed at Agartala for performance investigation. Moisture content of the natural rubber sheets dried in the solar thermal dryer was reduced from 40% to 4% vis-`a-vis 11% in open sun drying condition in 3 days' time on wet basis. Six drying models were studied and validated against the experimental data. The average energy and exergy efficiencies of the system for natural rubber sheet drying were 9.09% and 2.48% respectively. Quality of the solar dryer dried sheets were found to be superior to the open sun dried ones.	 
17	Bilal Lamrani Abdeslam Draoui	Modelling and simulation of a hybrid solar-electrical dryer of wood integrated with latent heat thermal energy storage system	The main objective of this study is to investigate numerically a novel design of an indirect hybrid solar-electrical dryer of wood integrated with latent heat thermal energy storage system. The studied wood dryer system is composed mainly of a drying chamber, a solar air collector, a thermal energy storage system with Phase Change Material (PCM) as storage medium and an electrical heater. Two numerical models for both drying chamber and thermal energy storage system are developed and validated with existing experimental data. These models are coupled with TRNSYS software standard library and a global model for the dryer system is presented.	
18	M.C. Ndukwu D. Onyenwigwe F.I. Abam A.B. Eke C. Dirioha	Development of a low-cost wind-powered active solar dryer integrated with glycerol as thermal storage	The paper presents an active mix-mode wind-powered fan solar dryer (AWPFS) with a passive mix-mode non-wind-powered solar dryer (PNWPS) evaluated with pre-treated potato slices. The two dryers were tested with and without glycerol as thermal energy storage. The objective was to present a non electricity powered active solar dryer using only clean energy sources. Evaluation of the dryer took place at ambient temperature range of 24e50 _C and humidity of 10e52%. The results indicate that drying with AWPFS integrated with glycerol showed shorter drying time than drying with AWPFS only or PNWPS.	

19	S.M. El-Bashir A.A. Al-Jaghwani	Perylene-doped polycarbonate coatings for acrylic active greenhouse Luminescent solar concentrator dryers	Red fluorescent Polycarbonate (PC) films were prepared by solvent-casting technique from PC solution doped with different dye concentrations of perylene dyestuff (KREMER Red 94720). The effect of the dye concentration on the structure and photophysical properties was studied using X-ray diffraction, UV–Vis and fluorescence spectroscopy. The optimum dye concentration of red fluorescent PC films showed the best emission efficiency for the doping concentration 0.3 wt%.	
20	Zakaria Alimohammadi Hadi Samimi Akhijahani Payman Salami	Thermal analysis of a solar dryer equipped with PTSC and PCM using experimental and numerical methods	This paper was aimed to evaluate the effect of fluid type on thermal performance of parabolic trough solar collector (PTSC). The simulation process was performed to predict thermal variations in receiver tube and storage tank by CFD. The experiments were conducted with 0.025 kg/s as air flow rate. Four fluid types including Nano-fluid (Al2O3, 4%), engine oil (10W40), glycerin and water and were considered for the performance analysis. Moreover, the drying process of the solar dryer was considered during the drying of apple slices with 5 mm thickness.	 

IV. METHODOLOGY

A. Determination Of Convective And Evaporative Heat Transfer Coefficients

The convective heat transfer coefficient (h_c) is most important parameter because heat transfer rate is highly depend on it. Here hc is calculated for mango papad all the conditions i.e open sun drying, inside the dryer without ETC, inside the dryer with ETC. Following relations are used to determine convective heat transfer coefficient.

$$h_c = \left(\frac{k_h}{Y}\right) \times Nu \quad (1)$$

Where Nu is the Nusselt number which is evaluated by using following relation

$$Nu = Ce(Re \times Pr)^n \quad (2)$$

Moisture evaporated (m_e) from the mango pulp with respect to time is determined by

$$m_e = \frac{q_e}{L_u} \times A_{bl} \times t \quad (3)$$

Where L_u is the latent heat of evaporation and q_e is the quantity of moisture evaporated which is determined by

$$q_e = 0.016 \times h_c[P(T_m) - \gamma i \cdot P(T_r)] = 0.016 \times \left(\frac{k_h}{Y}\right) \times [P(T_m) - \gamma i \cdot P(T_r)] \times N \quad (4)$$

Substitute the value of q_e from equation (8) to equation (7), than the equation (7) becomes

$$m_e = \left[\frac{0.016 \times k_c \times [P(T_m) - \gamma i \cdot P(T_r)] \times A_{bl} \times t}{L_u \cdot X}\right] \times Nu = Z \times Nu \qquad (5)$$

Where

$$Z = \frac{0.016 \times k_h \times [P(T_m) -\cdot \gamma i P(T_r)] \times A_{bl} \times t}{L_u \cdot Y}$$

With the help of equation (6) and equation (9), the Nusselt number is calculated as (Sahdev et al., 2017b),

$$Nu = \frac{m_e}{Z} = C(Re \times Pr)^n \qquad (6)$$

Logarithm of both sides will give,

$$\ln(Nu) = \ln(Ce) + n \cdot \ln(Re \times Pr) \qquad (7)$$

Hence the value of constants Ce and n are determined using the regression analysis as,

$$n = \frac{N \cdot \sum[\ln(Re \times Pr) \cdot \ln(Nu)] - \sum\ln(Re \times Pr) \cdot \sum\ln(Nu)}{N \cdot \sum[\ln(Re \times Pr)]^2 - (\sum\ln(Re \times Pr))^2} \qquad (8)$$

$$Ce = \frac{\sum[\ln(Re \times Pr)]^2 \cdot \sum\ln(Nu) - \sum\ln(Re \times Pr) \cdot \sum[\ln(Re \times Pr) \cdot \ln(Nu)]}{N \cdot \sum[\ln(Re \times Pr)]^2 - (\sum[\ln(Re \times Pr)])^2} \qquad (9)$$

Using the value of Ce and n, the convective heat transfer calculated by

$$h_c = \frac{k_h}{Y} Ce(Re \cdot Pr)^n \qquad (10)$$

In open sun drying condition, the Nusselt number is calculated by

$$Nu = \frac{m_e}{Z} = Ce(Gr \times Pr)^n \qquad (11)$$

The evaporative heat transfer coefficient (h_e) can also be calculated from below equation as

$$h_e = 0.016 h_c \left(\frac{P(T_m) - \varphi \cdot P(T_r)}{T_m - T_r}\right) \qquad (12)$$

B. Physical Properties of humid Air

The values of the thermo physical properties of humid air such as specific heat (C_h), thermal conductivity (K_h), density (ϱ_a), viscosity (μ), and partial vapor pressure P(T) are determined by using the following relations.

$$C_h = 999.2 + 0.1434 T_i + 1.101 \times 10^{-4} T_i^2 - 6.7581 \times 10^{-8} T_i^3 \qquad (13)$$

$$K_h = 0.0244 + 0.7673 \times 10^{-4} \qquad (14)$$

$$\rho_a = \frac{353.44}{(T_i + 273.15)} \qquad (15)$$

$$\mu_v = 1.718 \times 10^{-5} + 4.620 \times 10^{-8} T_i \qquad (16)$$

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V. RESULTS PROCURED AFTER PERFORMING EXPERIMENT

Table 1. Observations for Forced Greenhouse Drying of
(a) First Papad Sample (April 7, 2020).

Time	T_S	T_r	M_{ev} × (gm)	RH_{in} (%)
9:00 AM	37.1	52	0.026	0.18
10:00 AM	42.5	53.6	0.042	0.18
11:00 AM	44.9	57	0.046	0.15
12:00 AM	46.5	57.2	0.043	0.16
1:00 PM	47.8	57.8	0.043	0.18
2:00 PM	49.3	58	0.030	0.16
3:00 PM	47	53.7	0.024	0.16
4:00 PM	43.5	51.6	0.013	0.15
5:00 PM	40.4	43.7	0.082	0.19

(b) Second Papad Sample (April 8, 2020).

Time	T_S	T_r	M_{ev} × (gm)	RH_{in} (%)
9:00 AM	48.7	54.5	0.011	0.16
10:00 AM	54.9	55.9	0.011	0.15
11:00 AM	56.3	56.7	0.013	0.16
12:00 AM	61.8	55.2	0.012	0.18
1:00 PM	63.1	58.1	0.009	0.18
2:00 PM	62.2	59	0.007	0.15
3:00 PM	57.9	57	0.005	0.16
4:00 PM	48.2	46.1	0.005	0.17
5:00 PM	45.5	43.2	0.001	0.17

(c) Third Papad Sample (April 9, 2020).

Time	T_S	T_r	M_{ev} × (gm)	RH_{in} (%)
9:00 AM	55.9	53.1	0.003	0.17
10:00 AM	65	56.2	0.004	0.18
11:00 AM	65.6	57	0.002	0.18
12:00 AM	64.1	54.1	0.004	0.27
1:00 PM	66	56	0.001	0.17

(d) First Papad Sample (April 7, 2020).

Time	T_S	T_r	M_{ev} × (gm)	RH_{in} (%)
9:00 AM	38.8	37.4	0.04	0.35
10:00 AM	39.5	38.8	0.055	0.35
11:00 AM	42.1	41.5	0.053	0.32
12:00 AM	41.4	41	0.039	0.27
1:00 PM	45	42.6	0.036	0.25
2:00 PM	46.8	43	0.023	0.23
3:00 PM	41.9	40	0.013	0.21
4:00 PM	41.5	39.2	0.012	0.21
5:00 PM	38.8	36.5	0.008	0.27

(e) Second Papad Sample (April 8, 2010).

Time	T_S	T_r	M_{ev} × (gm)	RH_{in} (%)
9:00 AM	49.5	39	0.015	0.22
10:00 AM	53.7	39.5	0.01	0.3
11:00 AM	53.9	40.1	0.013	0.25
12:00 AM	56.5	42.3	0.014	0.22
1:00 PM	56	41.6	0.002	0.21
2:00 PM	53.7	42	0.005	0.19
3:00 PM	49.6	43.1	0.003	0.18
4:00 PM	49	39	0.003	0.2
5:00 PM	49.8	38.7	0.013	0.24

(f) third Papad Sample (April 9, 2010).

Time	T_S	T_r	M_{ev} × (gm)	RH_{in} (%)
9:00 AM	55.5	39.4	0.01	0.3
10:00 AM	55.4	40.6	0.003	0.24
11:00 AM	52.1	40.8	0.001	0.23
12:00 AM	54.4	41.6	0.002	0.18
1:00 PM	52.3	41	0.001	0.18
2:00 PM	51	43.2	0.002	0.18
3:00 PM	45.4	40.5	0.001	0.21
4:00 PM	44	39	0.001	0.21
5:00 PM	43.5	38.4	0.001	0.21

Table 3. Average Values of Constants (C and n) and the Convective and Evaporative Heat Transfer Coefficients.

C	n	Re	Pr	hc (W/m^2 ^{0}C)	he(W/m^2 ^{0}C)
0.9714	0.0129	1298.954	0.679	**0.0886**	**6.7583**

Table 3. Average Values of Constants (C and n) and the Convective and Evaporative Heat Transfer Coefficients.

C	n	Gr	Pr	hc (W/m^2 ^{0}C)	he(W/m^2 ^{0}C)
0.92138	0.04733	341476807	0.681898	**0.0747**	**3.2524**

VI. CONCLUSIONS

The convective and evaporative heat transfer coefficients for papad under forced convection greenhouse drying mode were evaluated by using the values of the constants (C and n) in the Nusselt number expression obtained for papad based on experimental data by using simple linear regression analysis. The values of the constant C and exponent n were found to be 0.9714 and 0.0129 respectively. The values of convective and evaporative heat transfer coefficients were observed to vary from 0.0747 W/m^2 ^{o}C to 0.0886 W/m^2 ^{o}C and 3.2524 W/m^2 ^{o}C to 6.7583 W/m^2 ^{o}C respectively. The average values of convective and evaporative heat transfer coefficients for papad drying under forced convection greenhouse mode were found to be 0.0886 W/m^2 ^{o}C and 6.7583 W/m^2 ^{o}C respectively. These values would be useful in designing a dryer for drying papad to its optimum storage moisture level. The experimental errors were found to be in the range of 23.23% to 44.88% by reading of article.

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