Analysis of Flat Plate Solar Dryer for Agriculture Products

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ABSTRACT

This study aims to analyze the performance and efficiency of a flat plate solar dryer for drying agricultural products.The design incorporates principles of solar energy utilization to provide a cost-effective and sustainable solution for drying crops and produce. Various parameters such as drying time, temperature distribution, and energy efficiency are evaluated to assess the dryer's effectiveness in preserving the quality of agricultural products while minimizing energy consumption.

The experimental results provide insights into the potential of flat plate solar dryers as an environmentally friendly alternative to conventional drying methods, with implications for enhancing food security and promoting sustainable agricultural practices.

Keywords: Solar dryer, flat plate, agriculture, drying efficiency, numerical simulation, post-harvest preservation.

1. INTRODUCTION

The use of solar energy for drying agricultural products has gained significant attention due to its potential to reduce post-harvest losses, improve product quality, and enhance food security. Among the various solar drying technologies, the flat plate solar dryer stands out as a simple, cost-effective, and environmentally friendly solution. This analysis aims to explore the design, operation, benefits, and challenges associated with flat plate solar dryers in the context of drying agricultural products flat plate solar dryers consist of a flat, insulated surface covered with a transparent material such as glass or plastic, beneath which agricultural products are placed for drying. The transparent cover allows sunlight to enter and heat the surface, creating a greenhouse effect. Heat is absorbed by the agricultural products, causing moisture evaporation. Ventilation systems facilitate airflow, carrying away the moisture and maintaining optimal drying conditions. Temperature and airflow control mechanisms ensure efficient drying while preventing over-drying or product spoilage.

2. LITERATURE SURVEY

A natural convection solar dryer(Cabinet Type) Dryer typically consist of a box like structure. Define the metrics to evaluate the performance of dryer. Nov2021.

Designed and developed a Mixed mode type forced convection solar tunnel dryer. M.A. Hossaina and B.K. Bala . Develop a conceptual design that combines both passive & force convection dryer. Ensure the dryer design is adaptable to different type of agriculture product. Jan2020.

Thermal evaluation of Indirect type solar dryer using flat plate collector. Mr..O. Balaji Evaluate the heat transfer processes with in the solar dryer. Developing strategies to optimize the design &operation of solar dryer. Feb 2019 .

Doubled Pass Solar Dryer (DPSD) was designed for drying red chilli. J. Banout Air is drawn into the dryer with the help of a small fan. Achieve optimal drying rates while maintaining product quality. Jul 2018

Designed a mixed-mode natural convection solar crop dryer (MNCSCD) . F.K.Forson Study existing mixed mode solar dryer design &analyze their performance in various condition. Aim for a design that minimizes environmental impact. Apr 2022 .

3.PROBLEM DEFINITION

1. Energy consumption and cost-effectiveness.
2. Suitability for various agricultural products (e.g., fruits, vegetables, grains).
3. Preservation of nutritional value and sensory characteristics.
4. Prevention of contamination and spoilage.
5. Use of sustainable materials and energy sources.
6. Size and dimensions of the flat plate solar dryer.

4. EXISTING METHOD

1. Monitoring changes in moisture content of the agricultural products during the drying process to determine drying rates and drying kinetics.
2. Investigating temperature variations across the drying chamber to ensure consistent and appropriate drying conditions.
3. Identifying opportunities for improving dryer performance, such as through design modifications or operational adjustments.
4. Assessing the environmental benefits of using solar dryers, such as reduced greenhouse gas emissions and energy consumption compared to fossil fuel-based drying methods.

5. PROPOSED METHOD

Conducting experiments to measure parameters such as temperature distribution, airflow rate, moisture content, and drying rate under different conditions.

Assessing the cost-effectiveness of the dryer, considering factors such as initial investment, operating costs, maintenance, and the value of the dried agricultural products produced.

Developing mathematical models based on heat and mass transfer principles to simulate the drying process. This involves equations for energy balance, airflow, moisture diffusion.

6. MATERIALS USED

- M.S. steel.
- Solar panel.
- Proximity Sensor.
- Polycarbonate sheet.
- Battery.
- Solar controller.
- Temperature Indicator.
- silver coated butyl polymer tape
- Metal handle
- Sponge
- welding equipment’s
- Temperature controller unit

7. METHODOLOGY

Selection of materials

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3D Design making.

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Purchasing of material

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M.S.steel used to make fabrication

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Solar panel and sensor are fixed.

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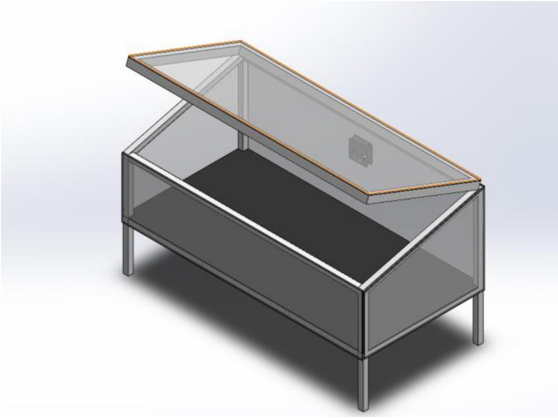
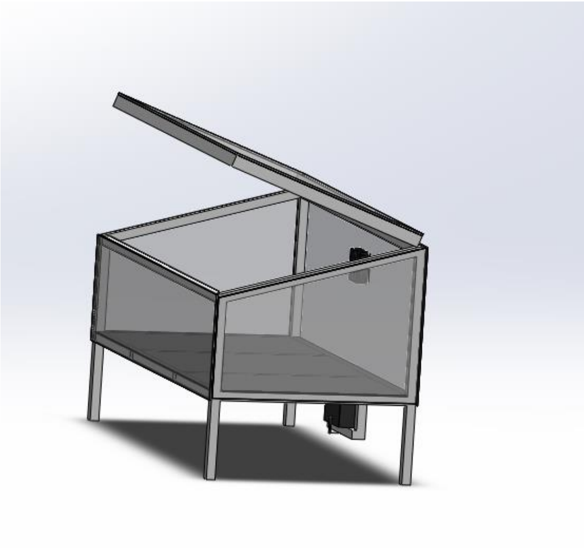
Introduction of new Flat plate solar dryer.



8. 3D DESIGN



9. MODEL

10. TABULATION

Product	Moisturecontent Intial %	Moisturecontent final %	Temperature
corn	24	14	45
Potato slice	71	13	40
Paddy	22	11	50
Ground nut	40	9	43

11. CONCLUTION

The analysis of flat plate solar dryers for agricultural products underscores their significant potential in addressing post-harvest losses, enhancing food security, and promoting sustainable agriculture practices.

Through the examination of various parameters such as efficiency, cost-effectiveness, and environmental impact, it is evident that flat plate solar dryers offer a viable solution for reducing moisture content in agricultural produce while minimizing energy consumption.

The findings highlight the importance of optimizing design, orientation, and operational parameters to maximize performance and overall effectiveness.

12. ACKNOWLEDGEMENT

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13. REFERENCE

[1] k.Amin Omda Mohamed , A natural convection solar dryer(Cabinet Type) - Nov 2021 .

[2] M.A. Hossaina and B.K. Bala Designed and developed a Mixed mode type forced convection solar tunnel dryer. - Jan2020

[3] Mr..O. Balaji Thermal evaluation of Indirect type solar dryer using flat plate collector - Feb 2019 .

[4] J. Banout Doubled Pass Solar Dryer (DPSD) was designed for drying red chilli. - Jul 2018

[5] F.K.Forson Designed a mixed-mode natural convection solar crop dryer (MNCSCD) - Apr 2022