



มหาวิทยาลัยราชภัฏนครปฐม

9673204

Drying and Storage

Course Description

Theory of drying, sun drying, principles of air flow, drying of agricultural products by heated air, moisture content determination, relationship of moisture and temperature, equilibrium moisture content, design of dryers, storage

Professional Interest Statement:

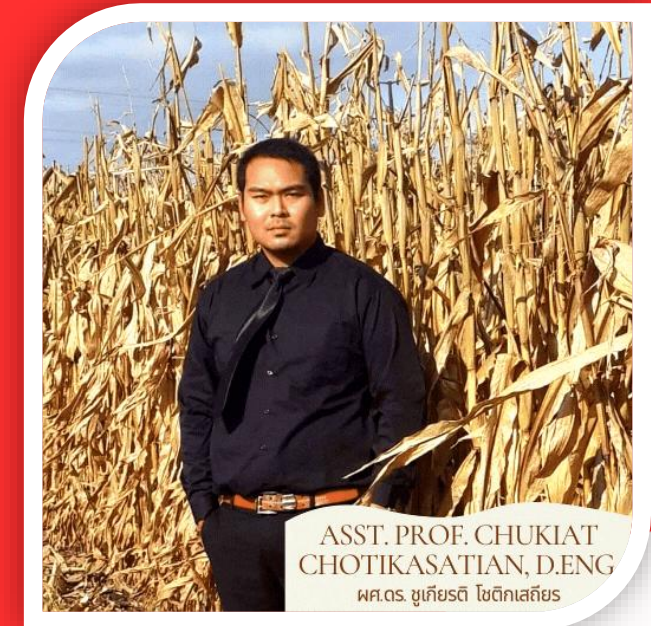
- Monitoring CO₂/O₂ concentrations to assess biological activity and reduce post-harvest losses
- Establishing verification criteria for unacceptable insect infestation levels
- Supporting fumigation and grain storage management decisions
- Developing agricultural product drying and intelligent drying systems

9673204 Drying and Storage

Assistant Professor Dr. Chukiat Chotikasatian



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Nakhon Pathom Rajabhat University



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Lecture 6 – Solar Drying

Study Questions – Lecture 6

- 1. Why is solar drying considered an important method for preserving agricultural products?*
- 2. How does airflow occur in natural convection solar dryers?*
- 3. What are the main differences between natural and forced convection solar dryers?*
- 4. What types of solar dryer structures are commonly used, and how do they affect airflow performance?*





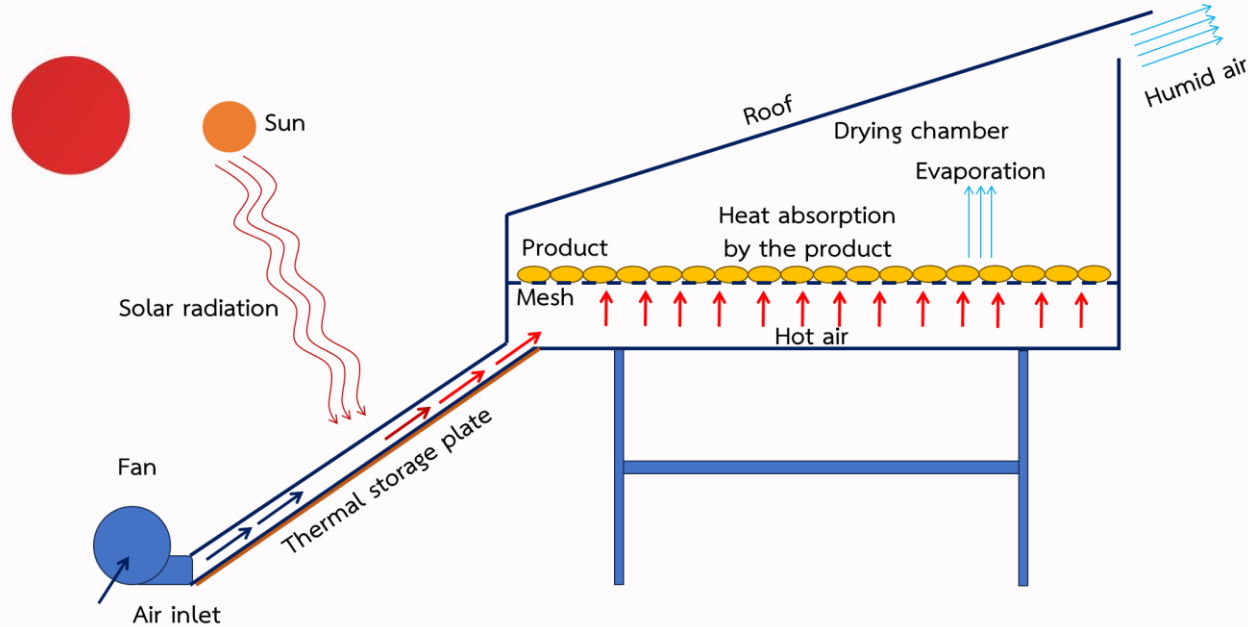
Lecture 6 – Solar Drying

Outline – Lecture 6

1. *Solar Drying Important*
2. *Solar Collector*
3. *A Natural Convection Solar Dryer*
4. *A Forced Convection Solar Dryer*
5. *Types of Solar Dryer Structures*
6. *The Current Applications of Solar Dryers*



Why is Solar Drying Important?



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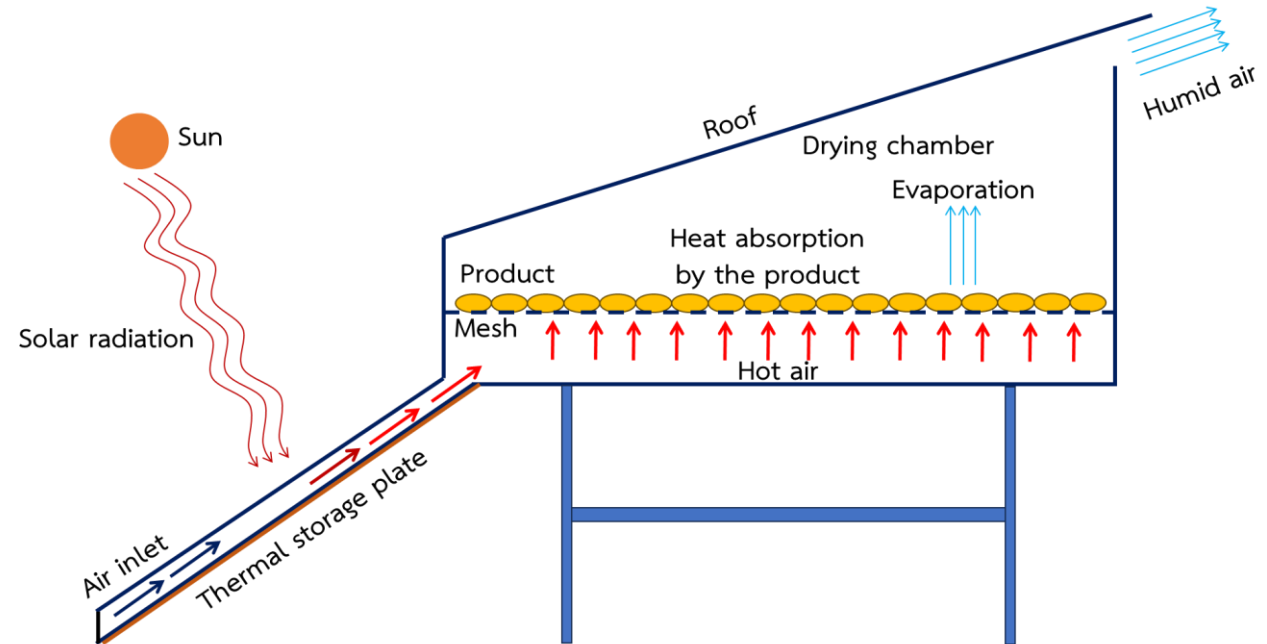
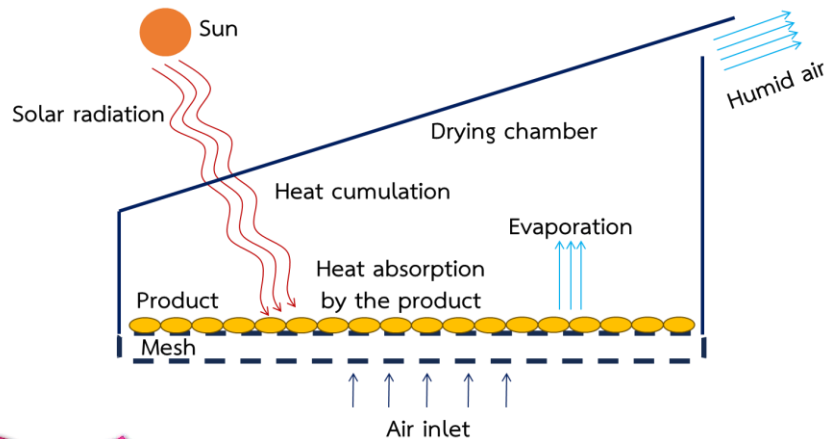
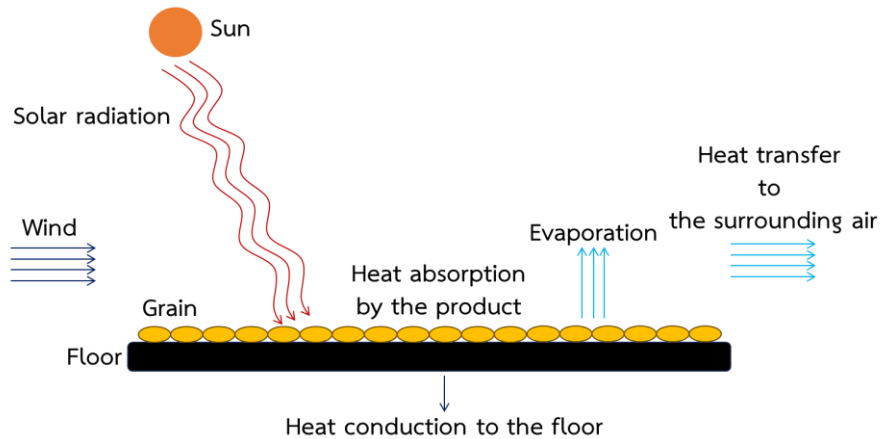


- Reduces moisture content to prevent microbial growth
- Minimizes post-harvest losses of agricultural products
- Extends storage life and maintains product quality
- Uses renewable solar energy and reduces energy costs
- Environmentally friendly and sustainable



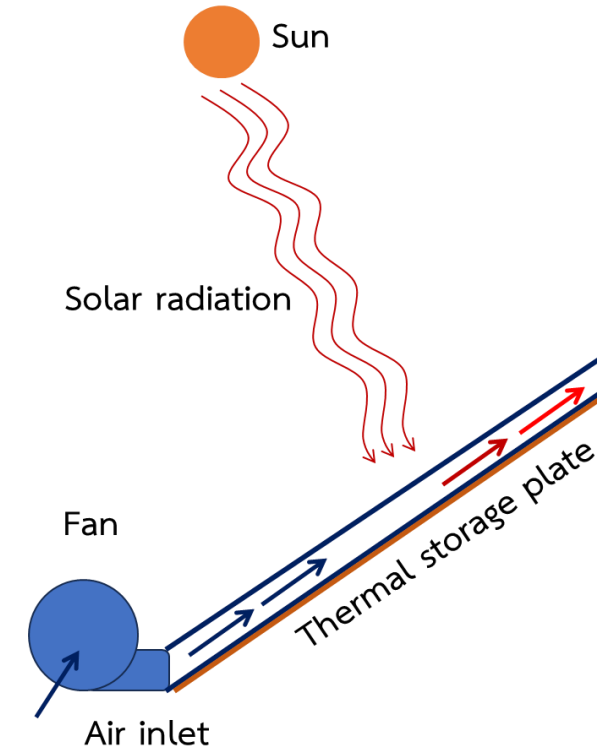
How can Drying Efficiency be Improved?

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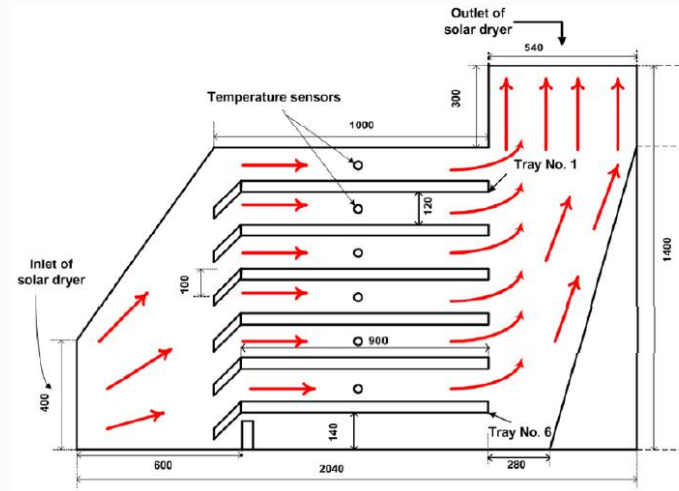


What is a Solar Collector and Why is it Important?

Type of Collector	Absorber Plate	Absorptivity of Absorber Plate	Emissivity of Absorber Plate
Without glass cover	Corrugated steel sheet painted black (small rounded corrugations)	0.69	0.64
Without glass cover	Corrugated steel sheet painted black (small rounded corrugations)	0.94	0.84
With glass cover (85% transmittance)*	Corrugated steel sheet painted black (small rounded corrugations)	0.94	0.89
With glass cover (87% transmittance)*	Corrugated steel sheet painted black (small rectangular corrugations)	0.94	0.89
With glass cover (100% transmittance)*	Corrugated steel sheet painted black (small rectangular corrugations)	0.95	0.89



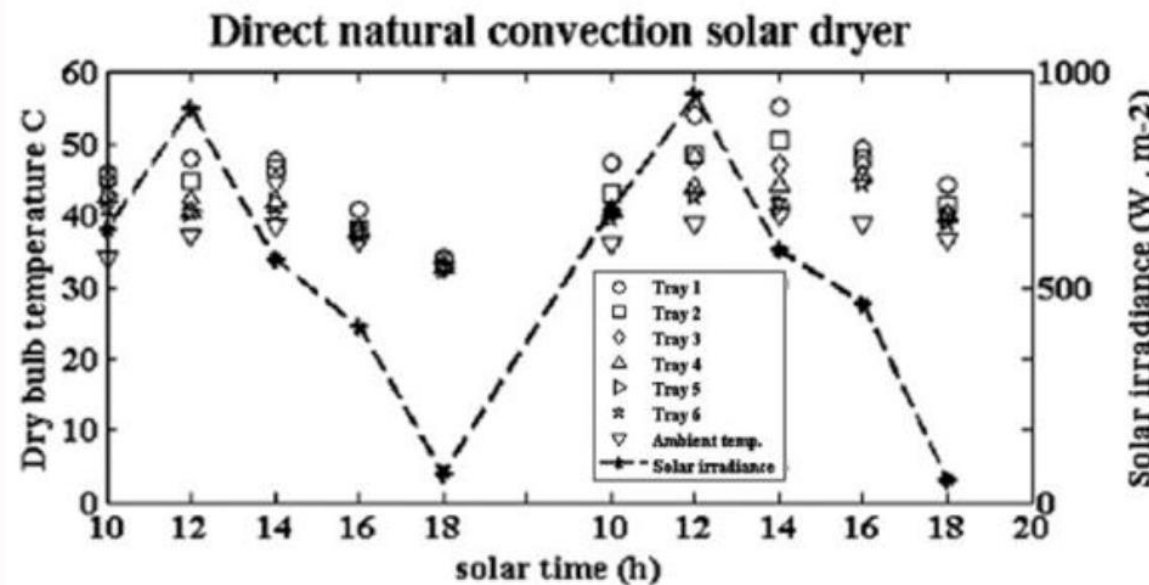
What is a Natural Convection Solar Dryer?



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- Solar drying system that uses natural airflow
- Air moves due to buoyancy (temperature difference)
- No fan or external power source required
- Simple and low-cost drying technology



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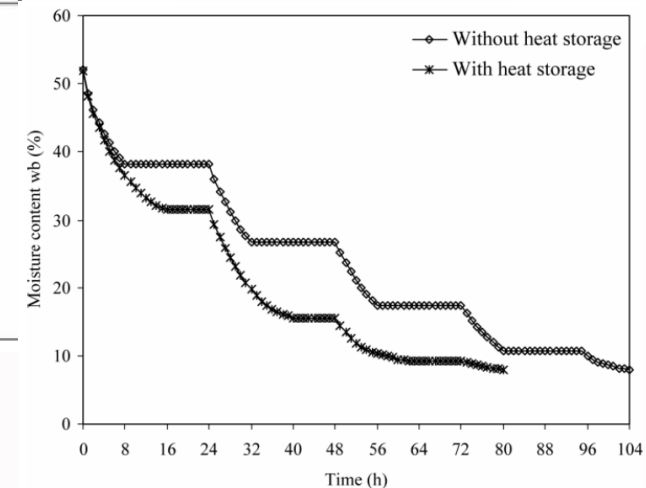
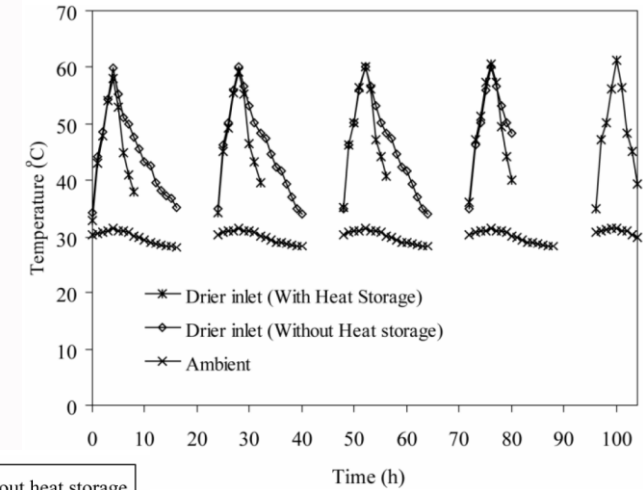
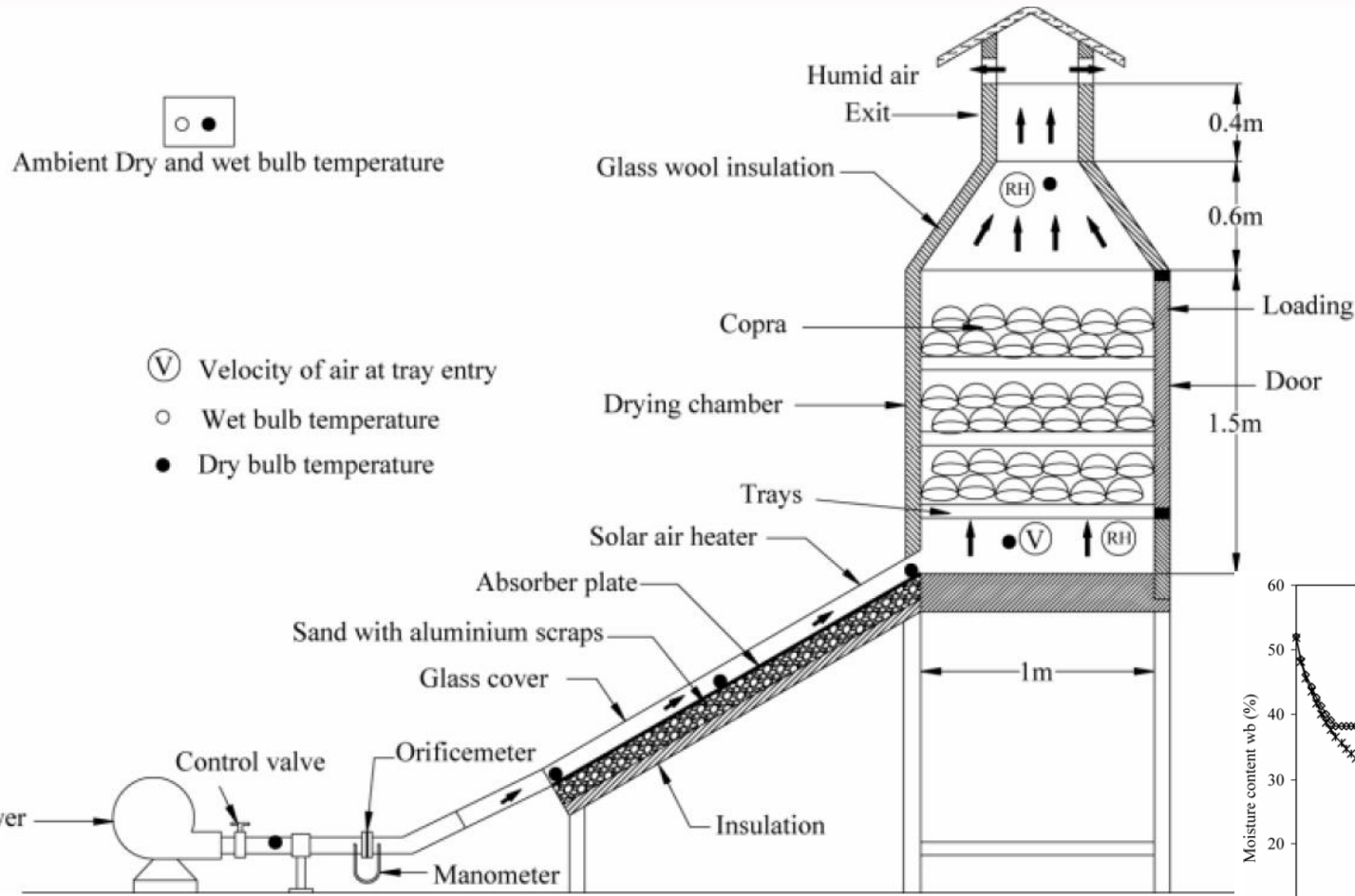
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Reference: Sallam et al., 2015, pp. 172-174



What is a Forced Convection Solar Dryer?

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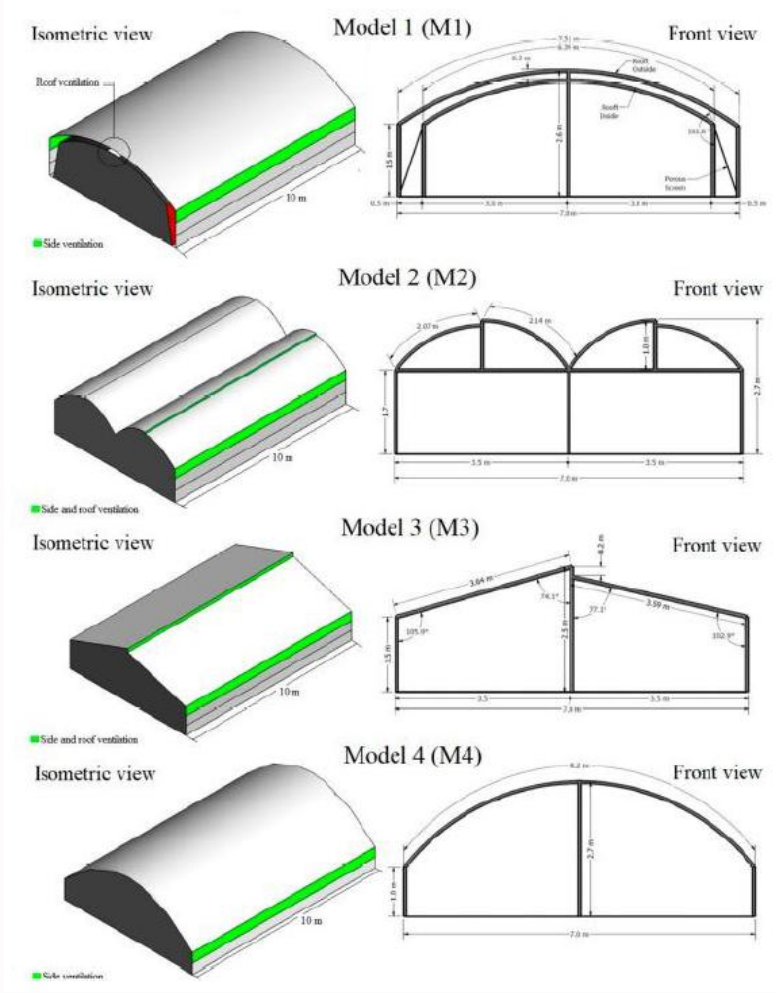
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Reference: Mohanraj & Chandrasekar, 2009, p.114, 118

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What Types of Solar Dryer Structures are Available?

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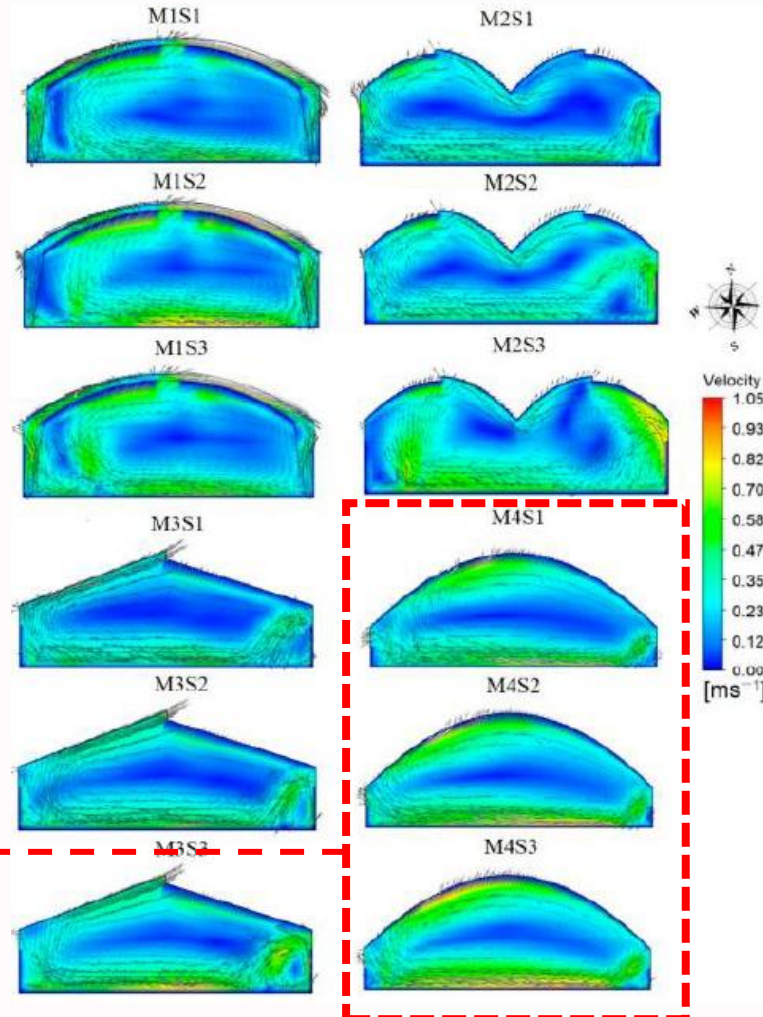
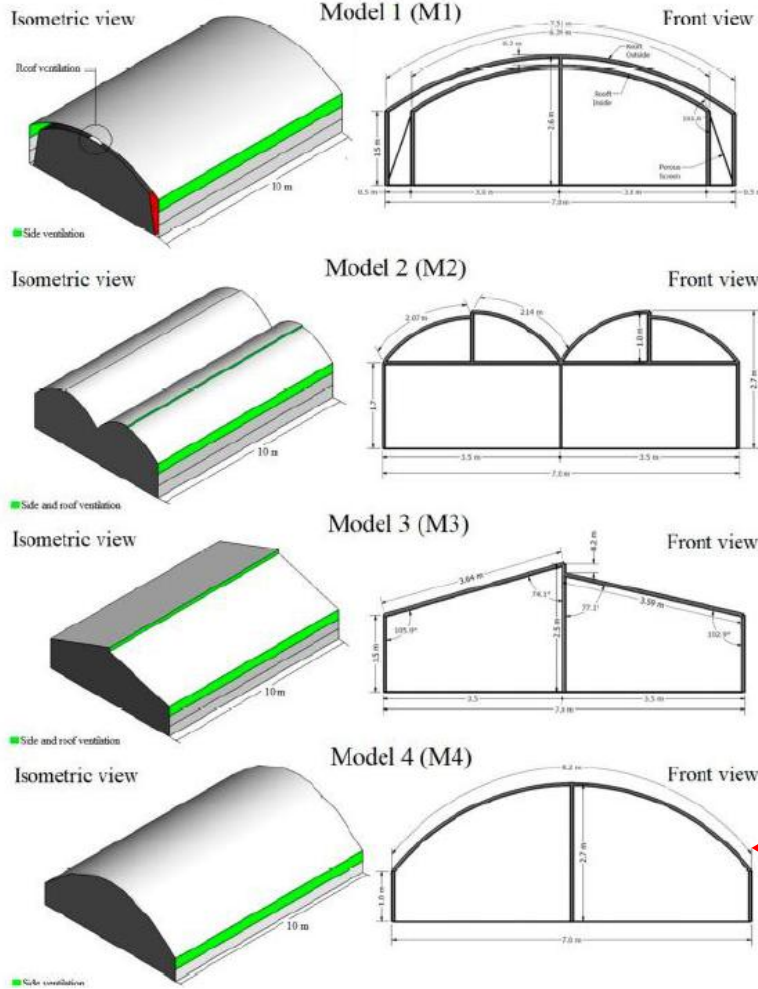


Reference: Villagran et al., 2021, p.4; Abdellatif et al., 2018, pp. 314-315



What Types of Solar Dryer Structures are Available? (Cont.)

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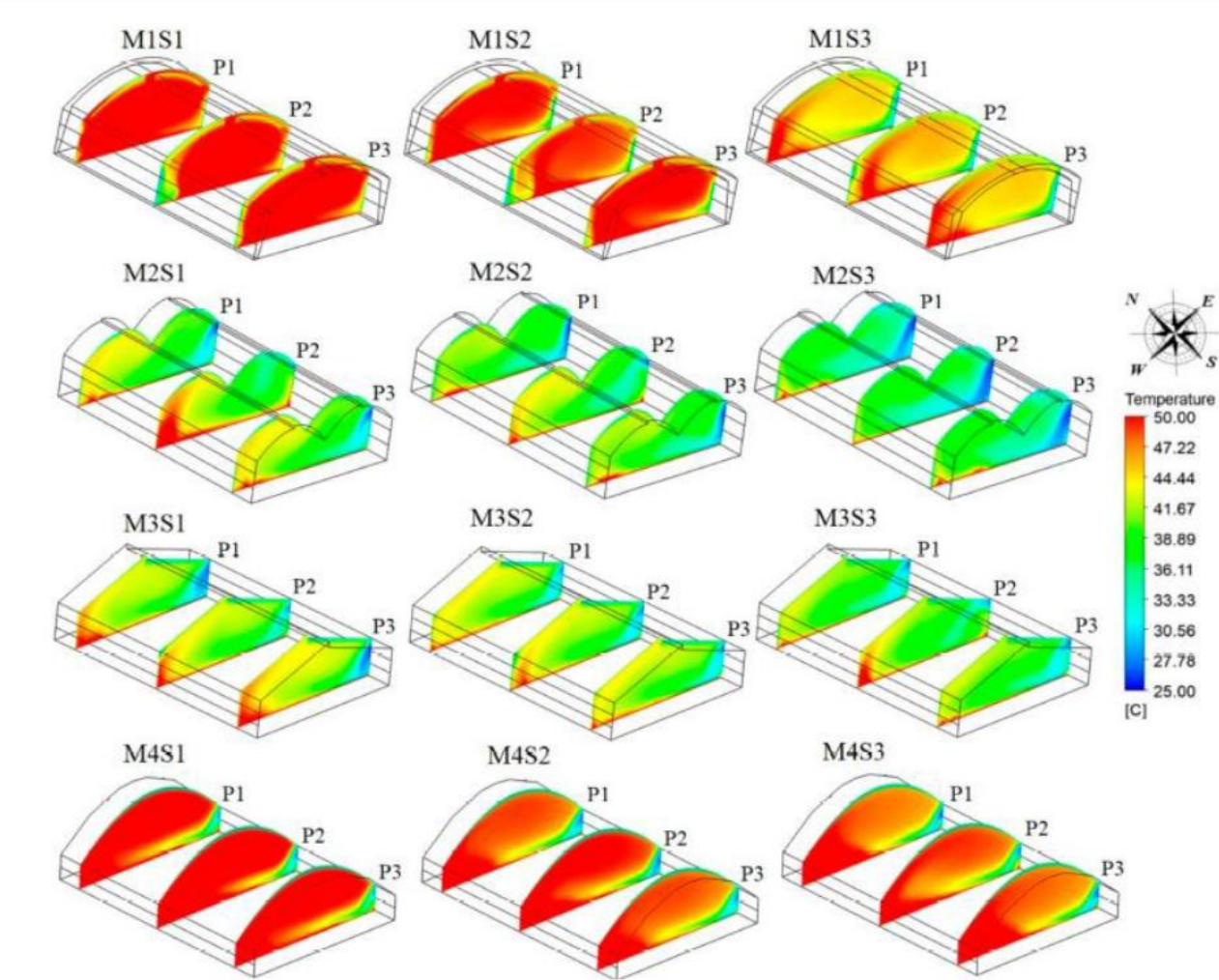


- In the simulation, the incoming wind speed was set at three levels: $0.21 \text{ (S1)} \text{ m}\cdot\text{s}^{-1}$, $0.62 \text{ (S2)} \text{ m}\cdot\text{s}^{-1}$, $1.05 \text{ (S3)} \text{ m}\cdot\text{s}^{-1}$
- The tunnel-type roof structure (M4) produced the highest internal air velocity because the smooth roof profile allows a more uniform flow distribution and results in lower frictional resistance



What Types of Solar Dryer Structures are Available? (Cont.)

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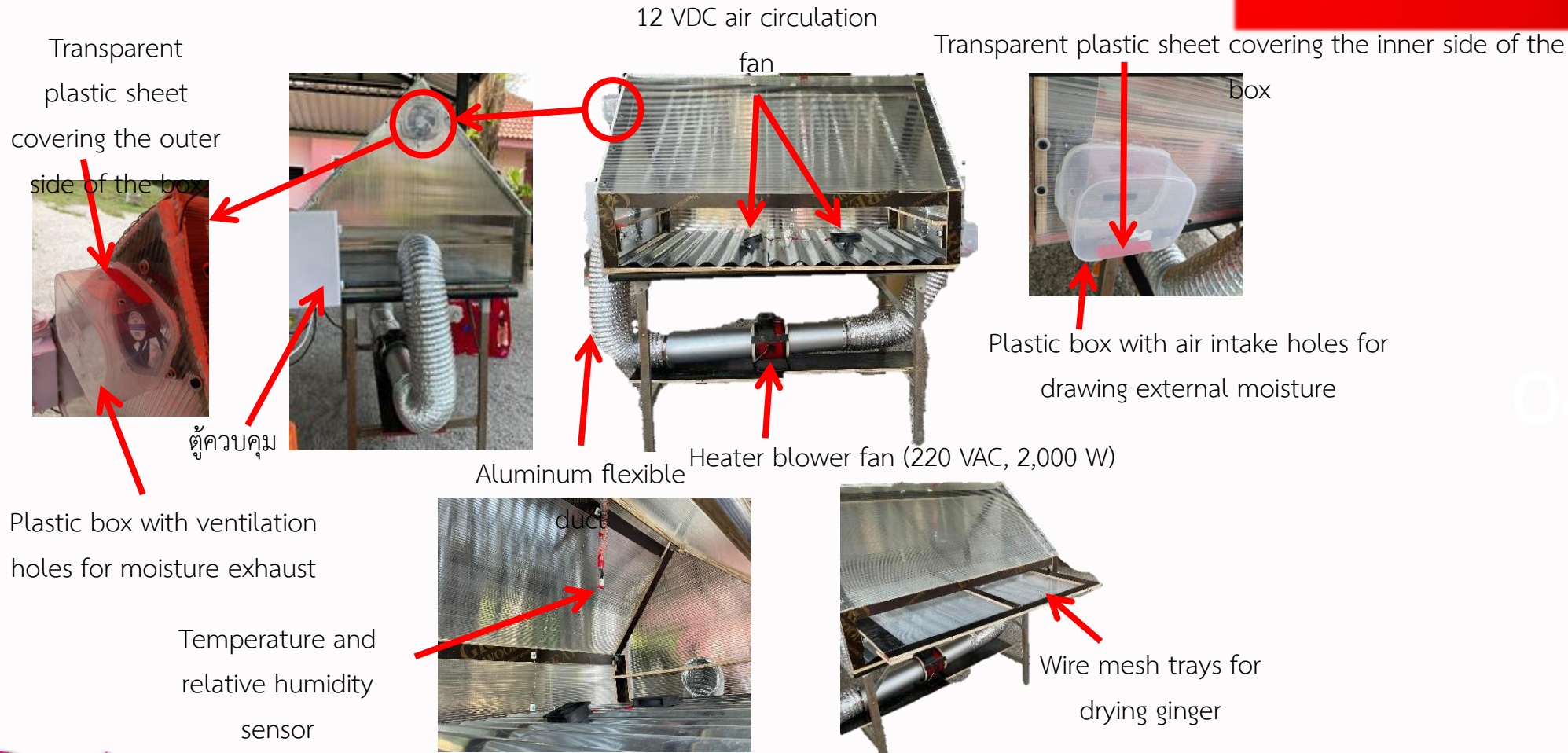
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Reference: Villagran et al., 2021, p.13

What are the Current Applications of Solar Dryers?

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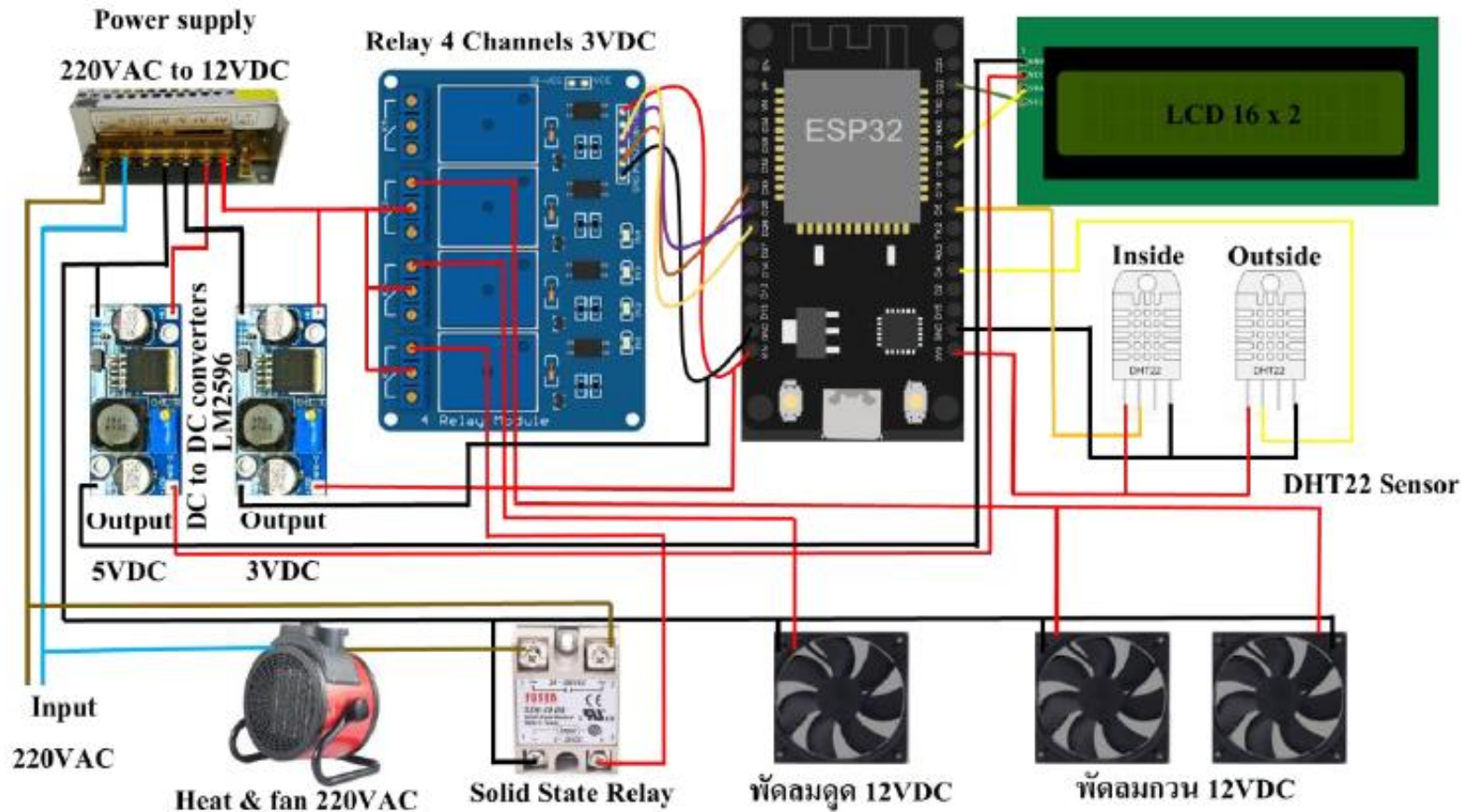
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What Are the Current Applications of Solar Dryers? (Cont.)

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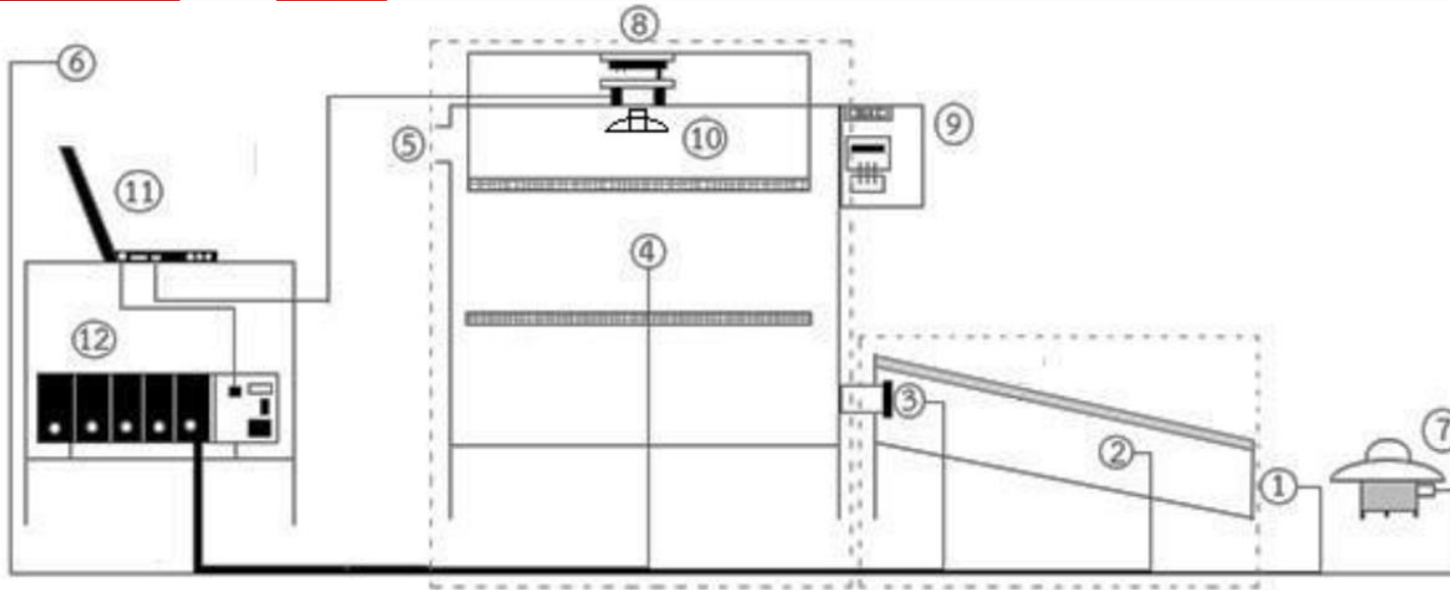
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Reference: Chotikasatian et al., 2022, p.554

What are the Current Applications of Solar Dryers? (Cont.)

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- (1) inlet temperature of the solar air heater (2) outlet temperature of the solar air heater
(3) inlet temperature of drying chamber (4) temperature of drying chamber
(5) outlet temperature of drying chamber (6) ambient temperature (7) pyranometer
(8) load cell (9) electric meter and temperature controller (10) Infrared tube
(11) computer (12) data logger

Reference: Dounporn et al., 2019, p.16



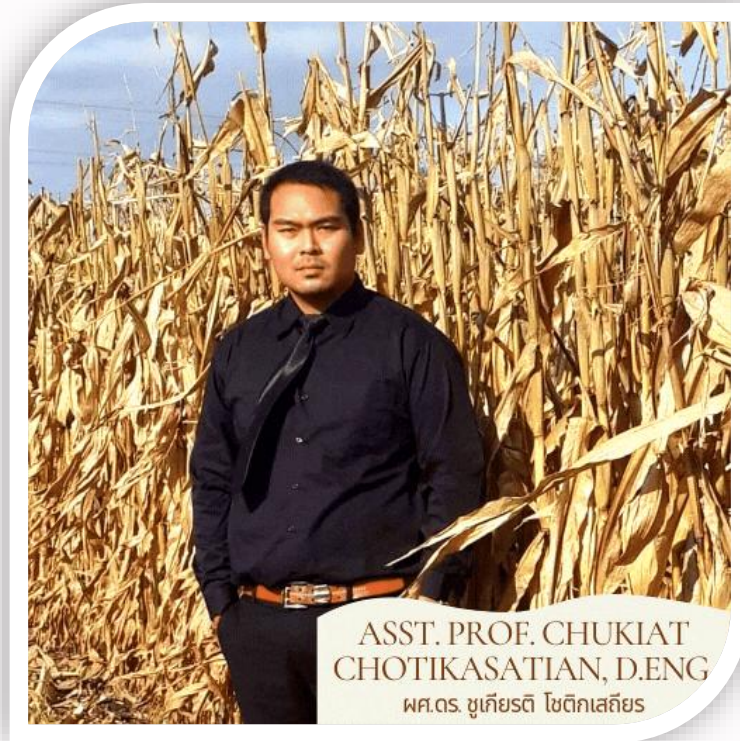
Summary

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1. Many studies have focused on improving solar drying efficiency by integrating additional technologies into solar drying systems
2. These technologies help accelerate moisture removal, resulting in significantly faster drying compared to traditional open sun drying
3. Advanced solar drying systems can improve product quality, reduce contamination risk, and enhance overall drying performance
4. However, the selection of drying structure and supporting technologies must consider investment cost, operational expenses, and economic feasibility for agricultural production





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Thank you very much for your kind attention.

Questions?

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Study Questions – Lecture 6

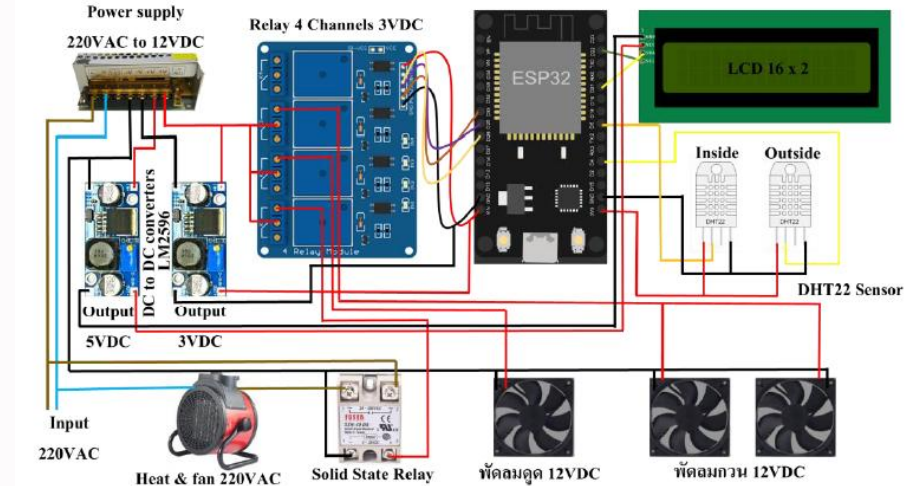
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Assignment – Lecture 6



1. Conduct a literature review on current solar dryers, including both natural convection and forced convection types.
 - Compare key features and performance.
 - Discuss experimental results reported in the literature.
2. Investigate solar drying systems integrated with technologies for performance enhancement (e.g., control systems, auxiliary heating, sensors). Explain the operating conditions. Describe the control strategy and control system components.
3. Collect and summarize the prices of control systems reported in the research studies (as shown in the figure). Present the results as an itemized list with prices. Provide a critical discussion assuming the dryer equipped with the system can produce $2 \text{ kg} \cdot \text{day}^{-1}$ of dried ginger.





References

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