

Design and fabrication of solar dryer A Review

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Abstract : This solar dryer offers several benefits, including improved drying speed, product hygiene, and quality retention. It's an eco-friendly, affordable, and technically efficient solution for post-harvest preservation, suitable for rural and small-scale applications. The design emphasizes simplicity, durability, and energy independence, making it a viable option for decentralized agricultural processing.

Overall, the solar dryer is a practical and sustainable solution for small-scale farmers and households, providing a reliable means of preserving agricultural products while reducing dependence on grid electricity and fossil fuels. Its compact design and portability make it an ideal choice for localized drying needs. The solar dryer is a compact, portable, and energy-efficient drying system designed for small-scale agricultural applications. Its cabinet size is 2 ft x 3 ft with a tapered height of 12-16 inches, allowing for improved solar radiation capture and natural air circulation. The structure is made of 18 mm particle plywood, chosen for its rigidity, ease of fabrication, and thermal insulation properties.

Key Words: : solar panel , temperature and humidity monitoring , charge controller , battery , DC fan , aluminium sheet , wood .

1. INTRODUCTION

Drying is one of the oldest and simplest methods of preserving food. When fruits, vegetables, or grains contain a high amount of water (moisture), they spoil quickly due to the growth of bacteria and fungi. By removing moisture, the food can be stored for a longer time without getting damaged.

Traditionally, farmers dry crops by spreading them under the sun in open areas. This method is called open sun drying. Although it is simple and low cost, it has many disadvantages. The food is exposed to dust, insects, birds, animals, and unexpected rain. Also, drying takes a long time and is not uniform.

To solve these problems, a Solar Dryer is developed. It is an enclosed box-type system that uses sunlight to dry food in a

clean and controlled environment. In this project, a compact and portable Solar Dryer has been designed and fabricated.

2. LITERATURE REVIEW

Several studies have been conducted on solar dryer .

1. Sharma and Kumar (2018) studied the performance of a natural convection solar dryer used for drying fruits and vegetables. Their study showed that solar drying reduces moisture content effectively and preserves food quality.
2. Patel et al. (2019) developed an indirect type solar dryer for agricultural products. Their research found that indirect solar dryers provide better hygiene and protect food from dust and insects.
3. Singh and Gupta (2020) designed a portable solar dryer for rural areas. The system improved drying efficiency and reduced drying time compared to open sun drying.
4. Kumar et al. (2022) analyzed different solar dryer designs and concluded that solar dryers are an economical and eco-friendly solution for food preservation.

From the literature review, it is clear that solar dryers help in reducing moisture content efficiently while maintaining food quality. However, there is still a need for a simple, low-cost, and portable solar dryer suitable for small farmers and household use.

2. COMPONENT

Components Used and Its Specifications

1. Frame structure
2. Solar panel
3. Air circulation system
4. Battery
5. Charge controller
6. Monitoring system

3.1 Frame Structure



The frame is the main structural part of the solar dryer . It supports all the components such as the DC fan, battery , temperature machine , charge controller and glass. Its cabinet size is 2 ft x 3 ft with a tapered height of 12-16 inches, allowing for improved solar radiation capture and natural air circulation. The structure is made of 18 mm particle plywood, chosen for its rigidity, ease of fabrication, and thermal insulation properties.

3.2 Solar panel



A Solar Panel works by converting sunlight into electricity. When sunlight falls on the solar panel, the solar cells inside the panel absorb the light energy. These cells work on the principle of the Photovoltaic Effect, which causes electrons to move and produce direct current (DC) electricity. This electricity can be used directly for small devices or can be converted into AC electricity using an Inverter for household use. In this way, solar panels generate clean and renewable electricity from sunlight.

3.3 Air circulation system



An air circulation system allows air to move continuously inside a system or chamber. In a Solar Dryer, fresh air enters and warm air removes moisture from the product. This air movement helps in faster and uniform drying.

3.4 Battery



A Battery is a device that stores electrical energy and supplies power to electrical devices. It converts chemical energy into electrical energy and is commonly used to store electricity from a Solar Panel.

3.5 Charge controller



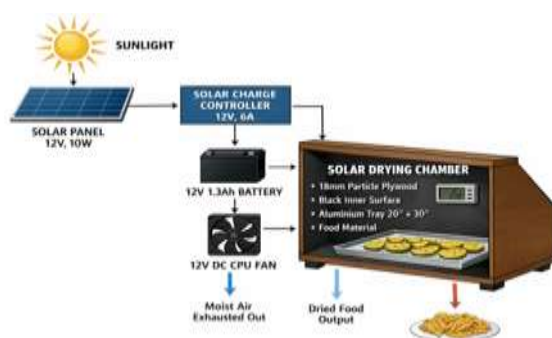
A Charge Controller is a device used in solar systems to control the electricity coming from a Solar Panel to the battery. It protects the battery from overcharging and over-discharging, helping to increase the battery's life.

3.6 Monitoring system



A temperature and humidity monitoring system is used to measure and observe the temperature and moisture level in the air. In systems like a Solar Dryer, it helps maintain proper drying conditions by continuously checking the temperature and humidity inside the drying chamber. This ensures better drying efficiency and good product quality.

3.7 BLOCK DIAGAM FLOW



4. WORKING MECHANISN

The system works by using energy from a Solar Panel to power the dryer and monitoring devices. Sunlight is converted into electricity and stored in a Battery through a Charge Controller. This power runs the air circulation system and sensors. The Solar Dryer then produces warm air that removes moisture from the product. At the same time, the monitoring system checks temperature and humidity to maintain proper drying conditions.

5 Advantages

- Renewable
- Portable
- Hygienic
- Low cost

6 Disadvantages

- Sunlight dependent
- Small capacity
- Battery maintenance

7 Applications

- Food preservation – Fruits, vegetables, grapes, chili, etc. can be dried to store for a long time.
- Agriculture products drying – Grains, spices, and seeds are dried using solar heat.
- Fish and meat drying – Used in coastal areas to dry fish hygienically.
- Medicinal plants drying – Herbs and medicinal leaves can be dried safely.

8. CONCLUSION

The Solar Dryer project demonstrates a simple, low-cost, and eco-friendly solution for drying agricultural products using renewable solar energy. The cabinet-type design with brown outer plywood surface and black inner coating improved heat absorption and insulation.

The integration of a 12V solar panel, battery, and charge controller ensured independent operation without grid electricity. The inclusion of a DC fan enhanced airflow, resulting in faster and more uniform drying compared to natural sun drying methods.

The system successfully achieved the main objectives:

- Utilization of renewable energy
- Reduction in drying time
- Hygienic drying environment
- Portable and user-friendly design
- Low operational cost

This project proves that small-scale solar dryers can effectively reduce post-harvest losses and support rural farmers. The design is simple enough to be replicated and commercially developed for small food processing units.

Overall, the developed Solar Dryer is efficient, economical, environmentally friendly, and suitable for small-scale agricultural use.

9. CALCULATION

TIME	CHAMBER TEMP (C ⁰)	AMBIENT TEMP(C ⁰)	RELATIVE HUMIDITY (%)	CROP INITIAL WEIGHT (g)	Final weight dry Condition (g)	Moisture removed (g)
0	37.5	35	18%	1500 g	1500	0
15	43.5	35	16%	1500 g	1475	25
30	48.4	35	14%	1500 g	1450	50
45	50.6	35	10%	1500 g	1425	75
60	51.4	36	10%	1500 g	1400	100
90	53.5	36	10%	1500 g	1350	150
120	53.9	36	10%	1500 g	1300	200

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