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Review Paper on Diffierent Types of Solar Dryer

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Abstract: ***One of the most appealing and economical uses of solar energy is drying agricultural goods. With differing degrees of technical performance, a multitude of solar dryer types have been devised and developed across the globe. In general, solar dryers come in four different varieties: (1) direct solar dryers, (2) indirect solar dryers, (3) mixed-mode dryers, and (4) hybrid solar dryers. The product being dried, as well as technical and financial concerns, are reviewed in this paper together with other solar dryer kinds. Technically speaking, integrated storage, high efficiency, compact collector design, and long-life drying systems are the main focuses in the development of solar-assisted drying systems for vegetables. There exist alternative systems to air-based solar collectors. By using a water-to-air heat exchanger, water-based collectors are another option. A water-to-air heat exchanger can be used to push hot air used for drying agricultural products to pass through it. As part of the solar drying system, the hot water tank stores heat.***

Keyword: solar dryer, types of solar dryer, direct types dryer, indirect types dryer, mixed-mode dryer, hybrid solar dryers.

I. INTRODUCTION

Food items that are dried usually last longer, including pickles, chillies, amlas, seafood, fruits, and spices. Food goods that have been dried are free of moisture and do not harbor bacteria, yeast, or other microorganisms that could cause moisture-related responses. Less weight and volume means less time and money spent on (i) packaging, (ii) storing, and (iii) transporting the food items. This is only one of the many advantages of drying. Food items are also more environmentally friendly after they have been dried.

A. Solar Dryer

Fruits, vegetables, and crops are dried using solar dryers to remove moisture. The solar dryer is comprised of a box constructed from readily available and reasonably priced materials like as plywood, cement, galvanized iron, and brick. Transparent single- and double-layered sheets cover the dryer's upper surface.

B. Types Of Solar Dryer

The main classification criteria for solar-energy drying systems are their modes of heating and how they use solar heat. They can be broadly divided into two categories:

There are three methods of drying: (i) sun exposure, (ii) direct drying, and (iii) indirect drying when solar radiation is present. The process of gathering solar energy and converting it into usable thermal energy determines how these modes operate in general.

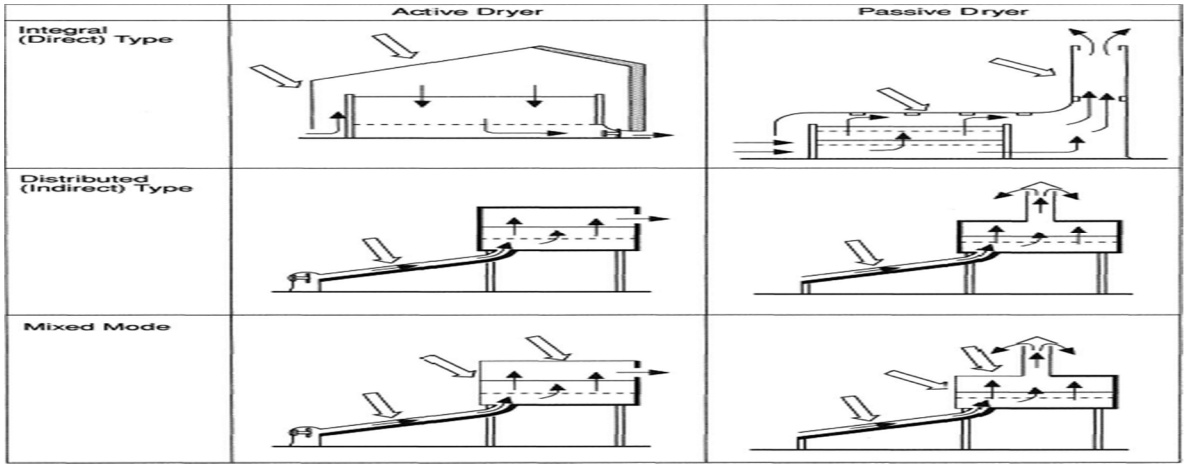


Fig 1 (a) Classification of Solar Dryer

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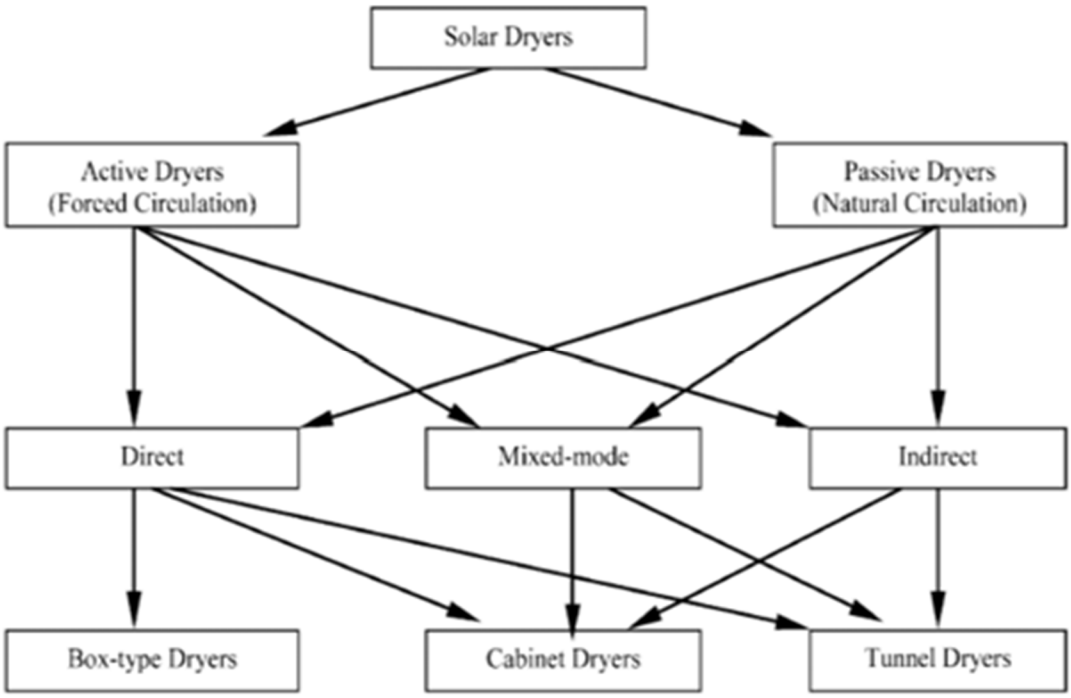


Fig 2 (b) Classification of Solar Dryer

There are three types of solar dryer

- Direct solar dryer
- Indirect solar dryer
- Mixed-Mode of solar dryer
- Open sun drying (OSD)

1) Open Sun Drying (OSD)

Grain that has been cut and spread out on a yard or field is typically subjected to open sun drying. Grain is sometimes spread out on a tarp or mat to minimize losses. The least expensive and resource-intensive drying technique is open sun drying, which works well for small batches. The crop is spread out thinly on the ground and exposed to the sun, wind, and other environmental factors during open sun drying (OSD). Part of the solar radiation that strikes the crop surface is absorbed, and some is reflected.

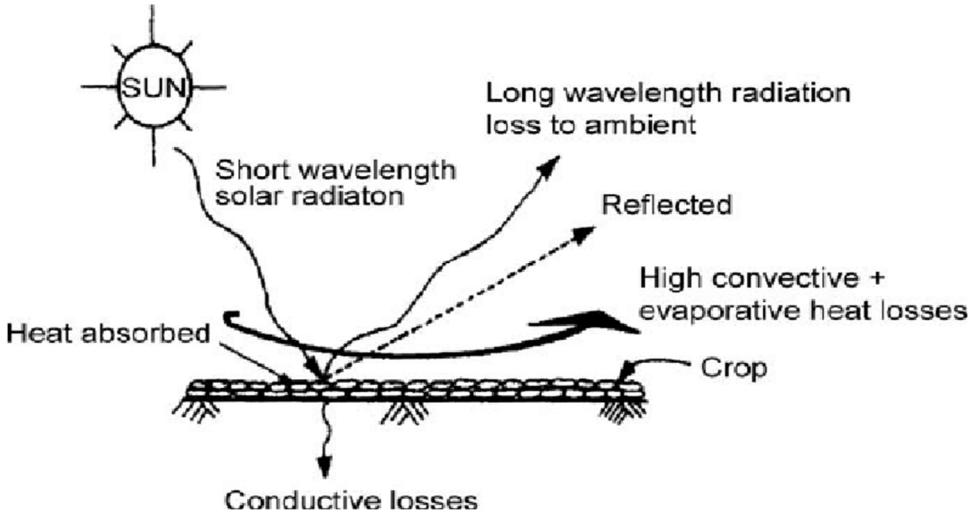


Fig 3 Open Sun Dryer

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2) Direct Solar Dryer

The sun is the only energy source used in all operations during direct solar drying. Solar radiation is incident on a transparent cover, usually made of glass or plastic, and the product can be exposed or protected.

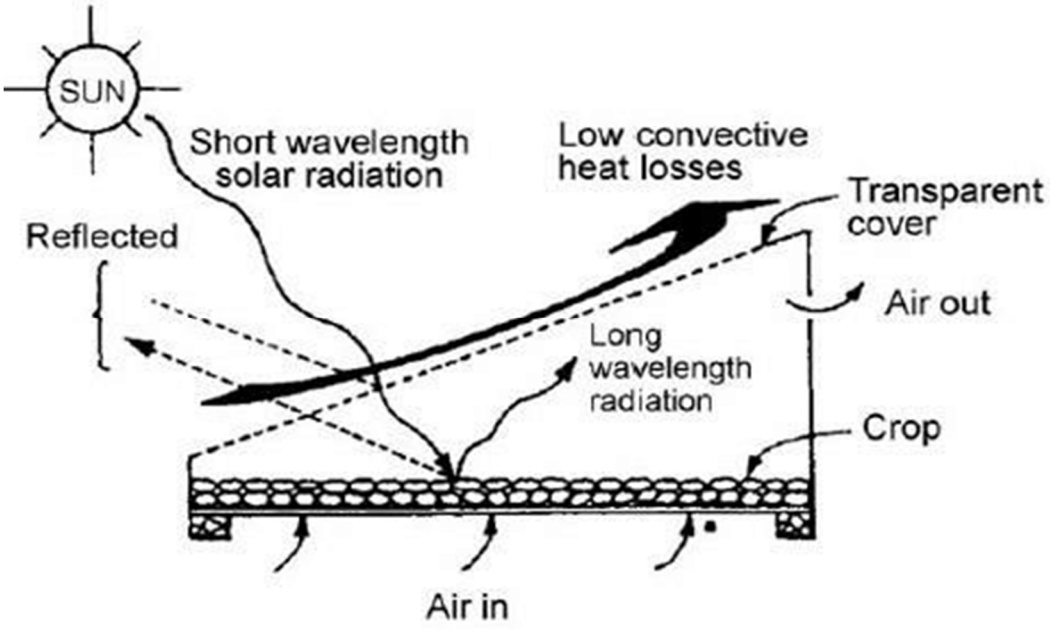


Fig 4 Direct Solar Dryer

3) Direct Type Dryers

Dryers of the direct kind resemble cabinets with a glass roofed chamber. Here, the commodity is directly exposed to solar radiation via the glass, which heats it due to the greenhouse effect. As shown below, the moisture is carried away by the airflow. This group includes tunnel, greenhouse, and cabinet-style dryers.

4) Tunnel Solar Dryer

The tunnel dryer is a machine where a container (tray) filled with the material is placed on a trolley or the material is loaded directly on the trolley, and the trolley is pushed in from the tunnel chamber entrance. The material is dried while being moved through the drying chamber.

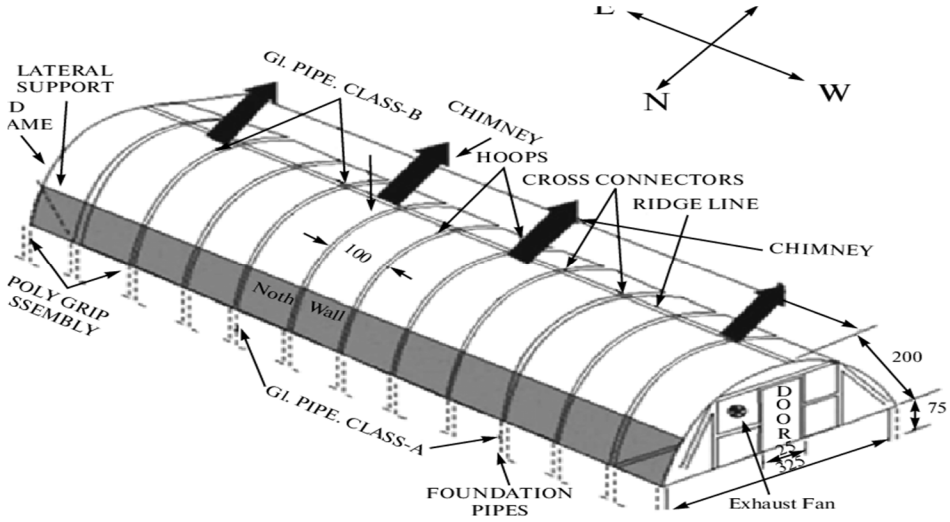


Fig 5 Tunnel Solar Dryer

5) Greenhouse Solar Dryer

The hybrid photovoltaic-thermal integrated greenhouse dryer is an integration of a greenhouse and PV modules that produce DC electrical power to operate a fan for forced mode operation and also provides thermal heating to the greenhouse environment. Heated air is drawn from bottom to top through a three-tier drying trays system. The UV stabilized polyethylene sheet fixed over the structural frame of the dryer helps in trapping infrared radiation. It also prevents unnecessary circulation of ambient air and thus maintains a desired temperature inside the greenhouse.

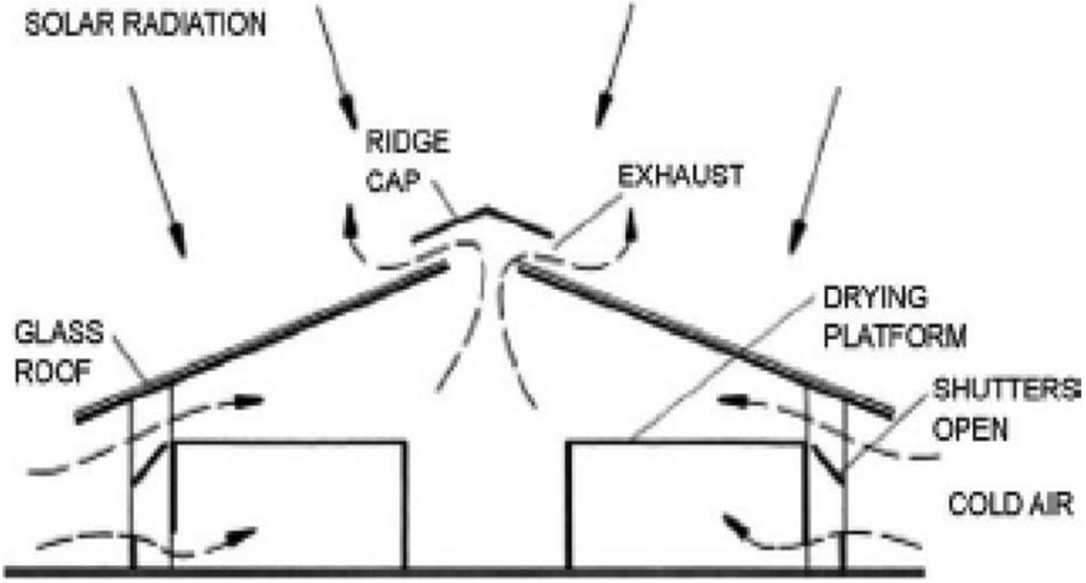


Fig 6 Greenhouse solar dryer

6) Cabinet-Types Dryer

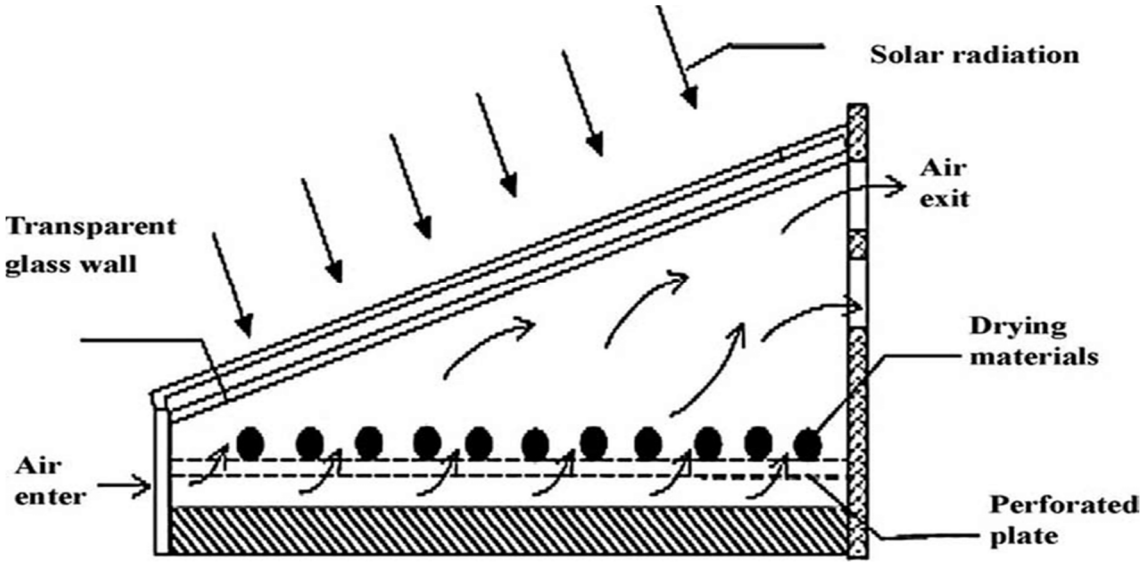


Fig 7 Passive Cabinet Food Solar Dryer

7) Indirect Solar Drying (ISD)

Indirect sun dryers work by heating incoming air through the black surface instead of the material that has to be dried directly. After passing over the material to be dried, the hot air leaves the area, frequently through a chimney, carrying the moisture the material has released with it.

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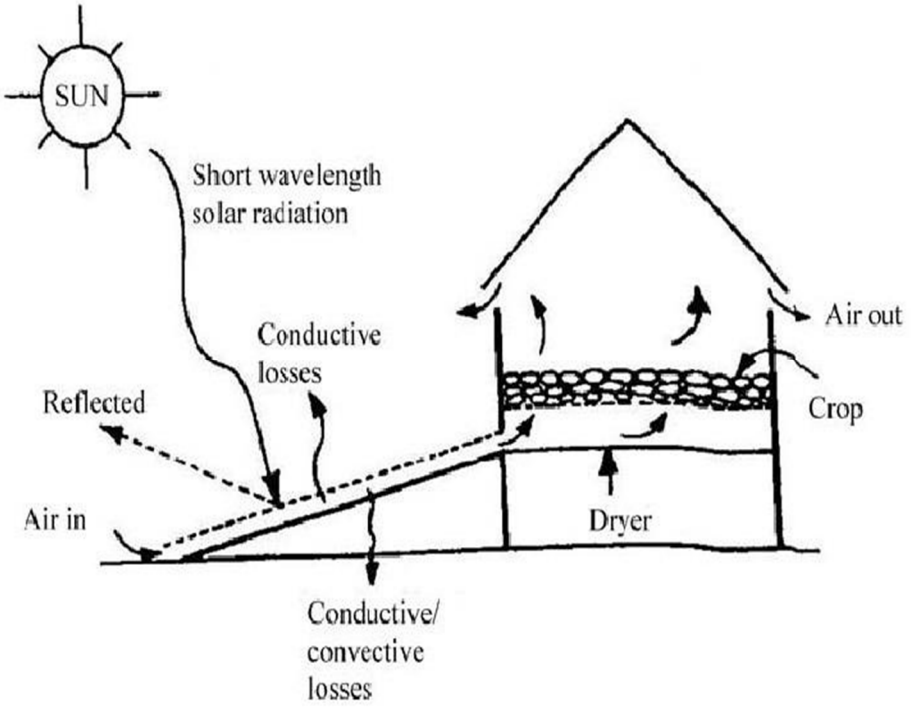


Fig 8 Indirect Solar Drying

8) Indirect Type Dryers

Airflow for drying and heating is separated into different chambers in indirect solar dryers. As seen in the image below, there is no direct contact between sun radiation and the commodity here. Warm air from the solar collector enters the airflow, which removes moisture from the drying chamber.

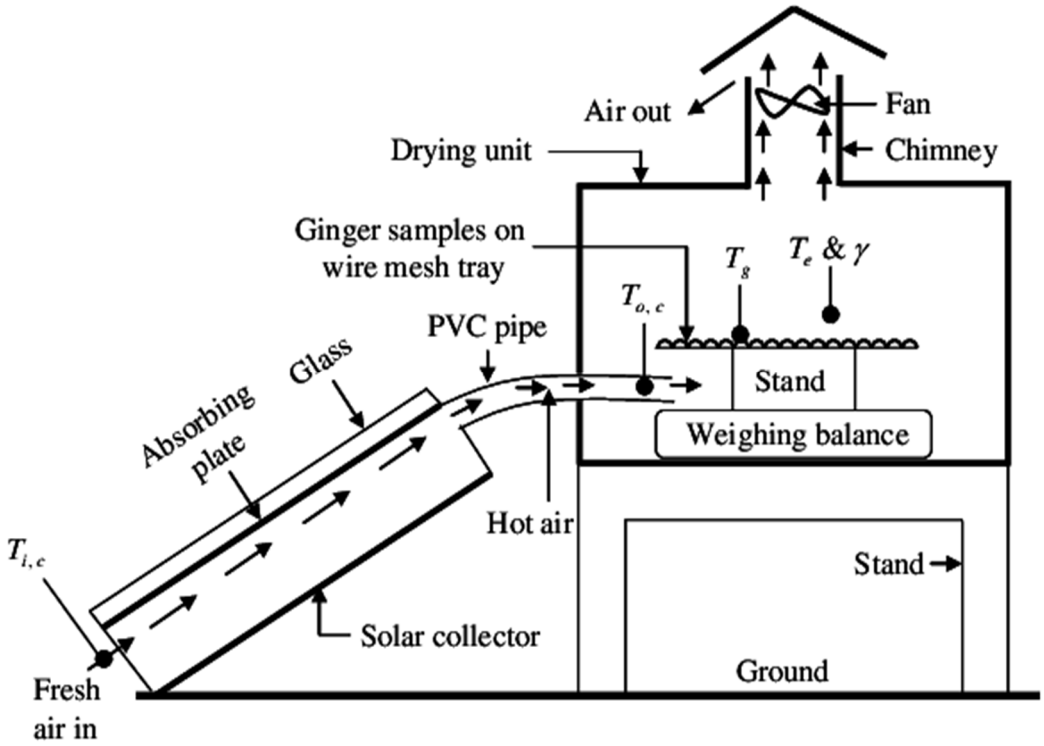


Fig 9 (a) Indirect Type Solar Dryer

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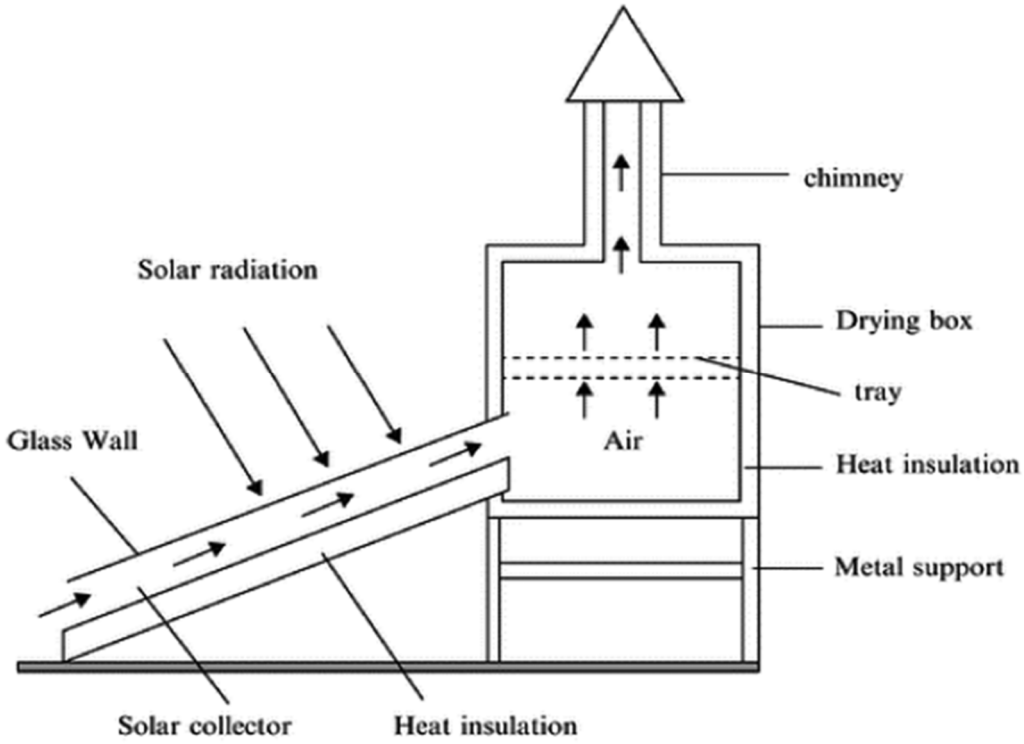


Fig 10 (b) Indirect Type Solar Dryer

9) Mixed-Mode Dryers

The two types mentioned above are combined to create mixed-mode dryers. The structure of the drying chamber is similar to that of an indirect drier, but it is transparent, allowing the greenhouse effect to heat both the drying chamber and the solar collector.

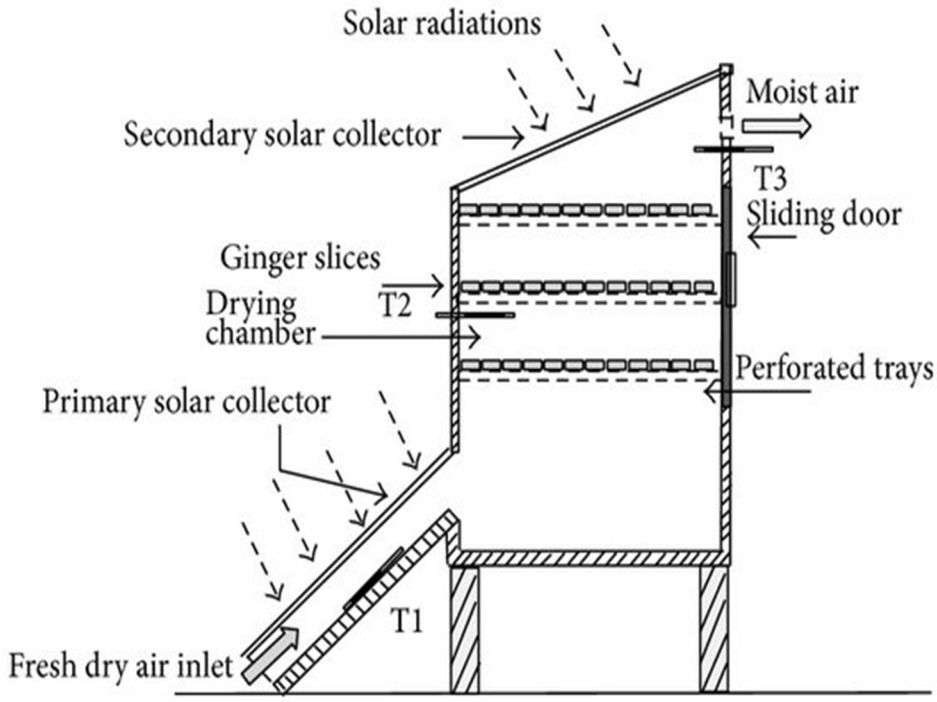


Fig 11 (a) Mixed-Mode Dryer

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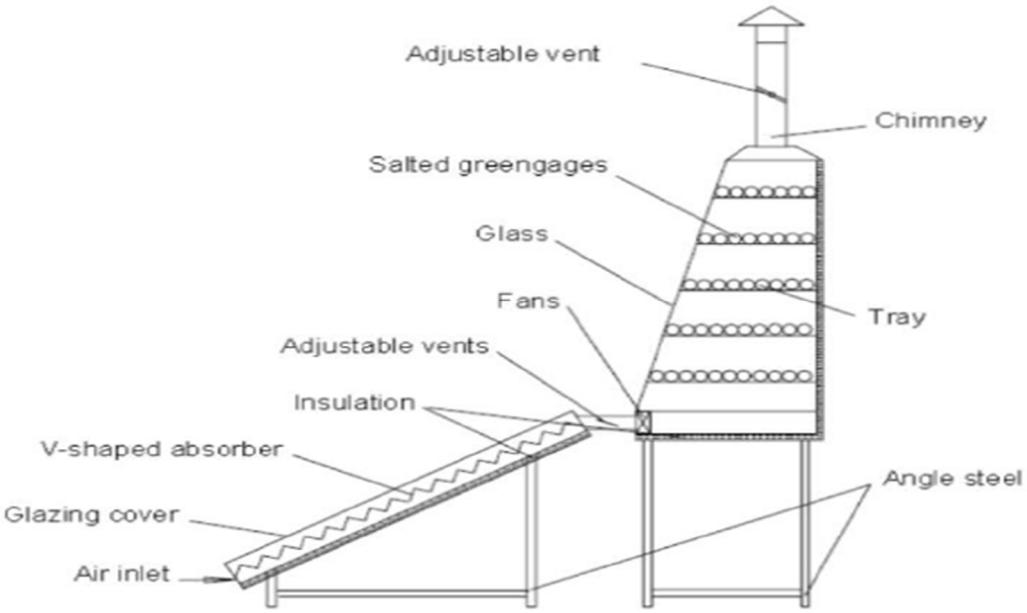


Fig 12 (b) Mixed-Mode Dryer

10) Hybrid Solar Dryers

A hybrid solar dryer uses heat produced by solar radiation (sunlight) and/or an external heater to dry food items including fruits, vegetables, herbs, spices, mushrooms, crayfish, etc.

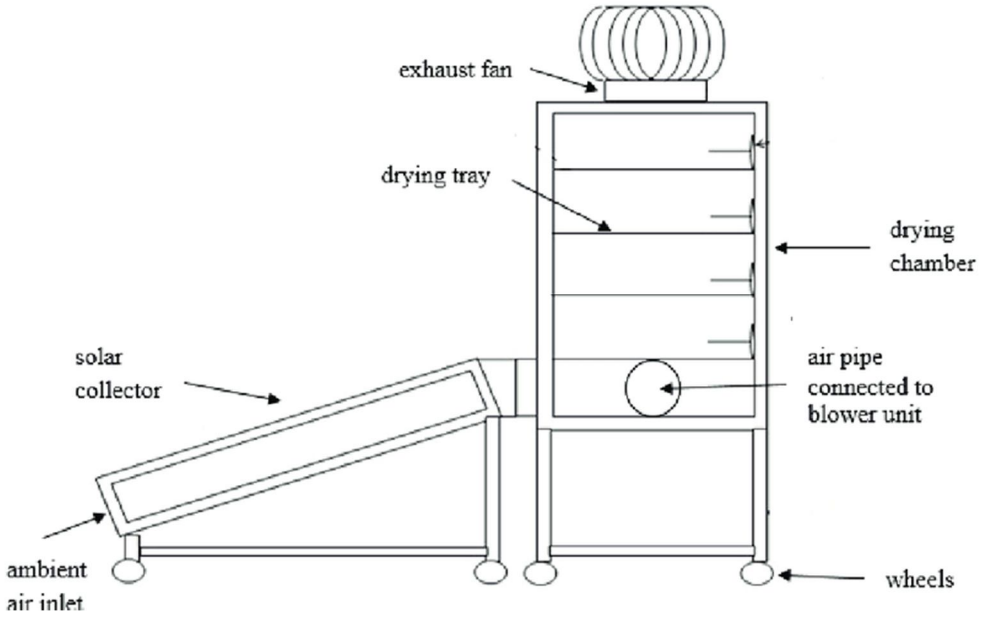


Fig 13 Hybrid Solar Dryers

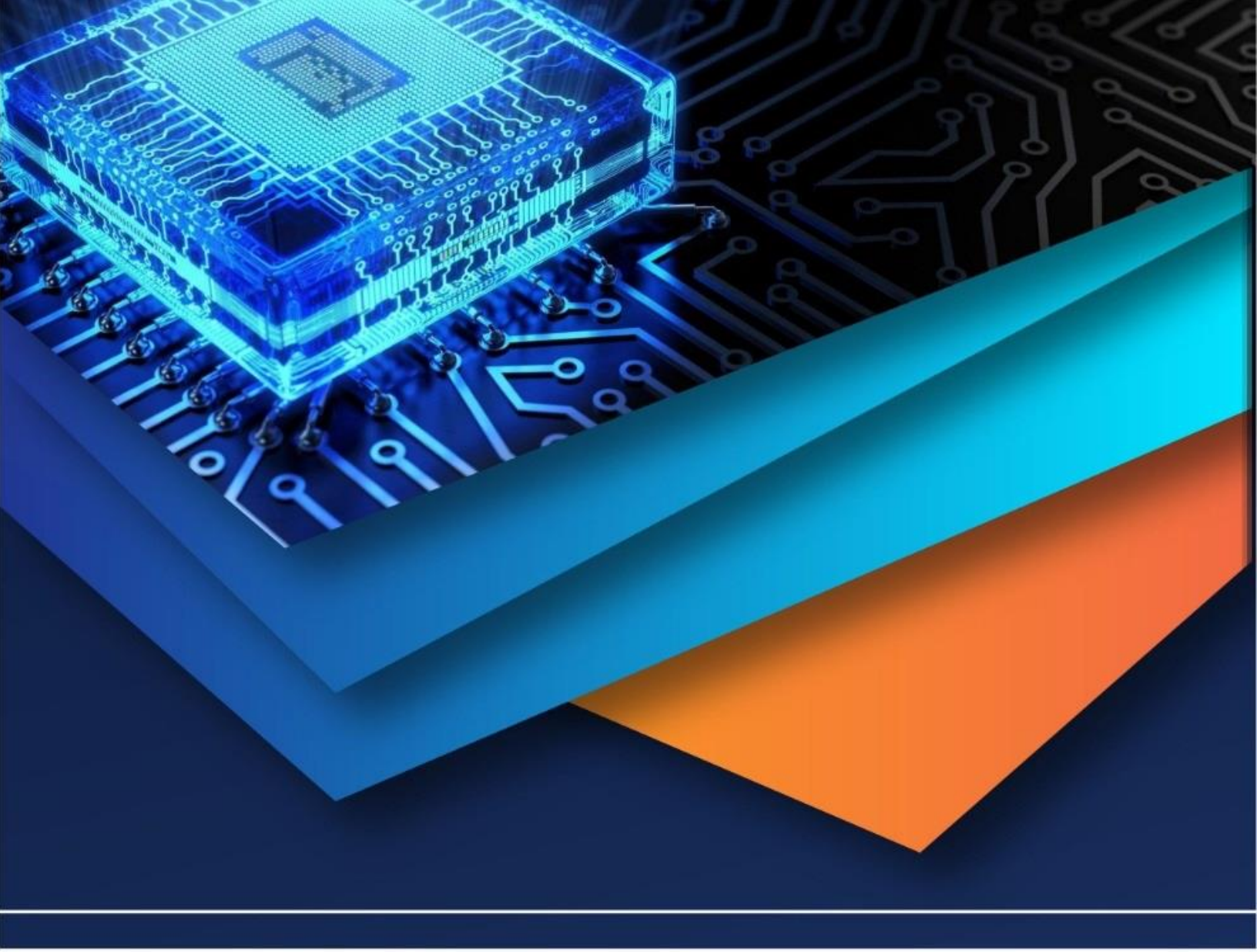
II. CONCLUSION

For several crops, solar dryness has shown to be advantageous both commercially and technically. Nonetheless, a big number of dryers must be developed so that farmers can be drawn in for a variety of products all year round. It's crucial to maintain temperature and relative humidity, protect against UV rays, dust, insects, mold, and other contaminant sources, and enhance product quality. Similar to this, sunshine items should be stored according to the crop; if the packaging is optimized, a long shelf life is needed.

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