

Shelf -Life Extension of Perishable Food Material by using Tray Dryer

Dhawale Shubham Namdev¹,
Nile Shubhangi Gorakhnath²

¹PhD scholar, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra

²PhD scholar, ICAR-Indian
Agricultural Research Institute,
New Delhi.

swapnaja20kjadhav@gmail.com

Drying is defined as the removal of a small amount of water or other liquid from a material by the application of heat or the final removal of liquid from solids by vaporization with the aid of heat. The equipment used for drying is called a dryer. The main purpose of drying is to avoid or eliminate moisture which may lead to corrosion and decrease the product or drug stability, to improve or keep the good properties of a material examples flowability, compressibility, to reduce the cost of transportation of large volume materials, to make the material easy or more suitable for handling.

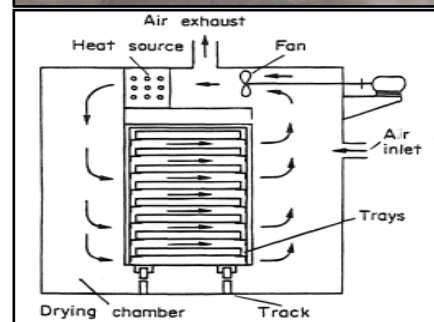
In the world for food drying include tray and tunnel dryers, spray, roller and freeze dryers. With the exception of tray dryers, none of these are appropriate, in terms of cost and output, for use by small and medium enterprises. In the early 1980's the need for small, controllable, powered tray dryers capable of producing high quality products that could be constructed by engineers in developing countries to a great

extent from locally available materials.

India is one of the largest producers of vegetables in the world. The fruit production is estimated to be 110.21 million Tonnes in 2022-23, mainly due to increases in the production of Apples, Banana, Grapes, Mango and Watermelon. Production of vegetables has increased from 209.14 million Tonnes in 2021-22 to 212.55 million Tonnes in 2022-23. Traditional sun-drying requires time and is laborious work and several studies highlighted that traditional sun drying is not suitable for some valuable heat-sensitive fruits and some vegetables So, to extend the shelf life, maintain availability and reduce loss of perishable commodities such as fruits and vegetables long term storage by removing moisture is most important. This article gives us a detail about tray drying.

Taray dryer

Tray dryers is widely used equipment designed to remove moisture from various substances typically in batch quantities.



Tray Dryer

Principle

In-tray dryer, hot air is continuously circulated. Forced convection heating takes place to remove moisture from the

solids placed in trays. Simultaneously most air is removed partially⁹. Heat transfer is increased and local flour concentrations are reduced with this process. Heat is applied to the air, which is then oriented towards the object under controlled flow. Trays with tiers are used to disperse the material to be dried. Perforated screens in trays are lined with paper to allow air to circulate across the drying materials. As air passes over every shelf, a limited amount of heat is provided to induce vaporization. This type of dryer maintains both humidity and temperature properly.

Construction

It consists of a rectangular chamber whose walls are insulated. Trays are placed inside the heating chamber. The number of trays may vary with the size of the dryer. Dryers of laboratory size may contain a minimum of 3 trays, whereas dryers of industry size may contain more than 20 trays. Each tray is rectangular or square and about 1.2 to 2.4 meters square in area. Trays are usually loaded from 10.0 to 100.0 mm deep. The distance between the bottom of the upper tray and the surface of the substance loaded in the subsequent tray must be 40.0mm.

Working

Wet solid is loaded into trays. Trays are placed in the chamber. Fresh air is introduced through the inlet, which passes through the heater and gets heated up. The hot air is circulated by means of fans at 2 to 5 meters per second. Turbulent flow lowers the partial vapor pressure in the atmosphere and also reduces the thickness of the air boundary layer. The water is picked up by air. As water evaporates from the surface, the water diffuses from the interior of the solid by capillary action. These events

occur in a single pass of air. The time of contact is short and the amount of water picked up in a single pass is small. Therefore, the discharged air to the tune of 80 to 90% is circulated back through fans. Only 10 to 20% of fresh air is introduced. Moist air discharged through the outlet. Thus, constant temperature and uniform airflow over the material can be maintained for achieving uniform drying. In the case of wet granules, drying is continued until the desired moisture content is obtained. At the end of the drying, trays are pulled out of the chamber and taken to a tray dumping station. A schematic diagram of the tray dryer. Sticky material, granular mass, or crystalline material can be dried in a tray dryer. In-tray dryer mainly involving advantages are handling of materials can be done without losses, and the same equipment is readily adjusted with the chemical industry. The demerits of tray dryers require more labour to load and unload hence cost increases, and also the process is time-consuming.



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Uses

1. Chemicals and pharmaceuticals are two

industries where tray dryers are used.

2. Tray dryers are well suited to drying sticky materials, granular mass or crystallized materials, precipitates, and pastes.
3. Agricultural drying has been made possible with its simple design and capacity to dry large quantities of products.

Merits

1. Each batch is handled separately since it is operated in a batch mode.
2. It is an energy-efficient dryer since it consumes less energy. Using and cleaning it is simple.
3. The tray dryer can be customized to fit different sizes, which reduces the capital cost. External heating prevents condensation on chamber walls.
4. It has a unique design with a single chamber or a multi chamber in which there is no leakage.
5. The shelf and tray have excellent surface contact.
6. Wet lumpy solids and wet cakes, for example, can be dried using this method in small-scale production.
7. All connections are outside the chamber with a heavy-duty hollow shelf design.
8. Controlling operating parameters is easier.
9. When heat-sensitive materials need to be dried, vacuum systems can be most suitable.

Demerits

1. The process is time-consuming because it runs at low to intermediate temperatures.
2. Indirectly exposed solid particles makeup only a fraction of the total.
3. Neither heat nor mass is transferred efficiently.
4. The dryer is not suitable for mass production. In the lower trays, the contents are prone to over-drying.

Conclusion

While tray drying offers a promising solution for extending the shelf life of fruits and vegetables, its adoption faces hurdles like high initial costs and long processing times. However, the benefits of reduced drying time, minimized losses, and easier operation make it a potentially valuable technology, especially for developing countries.