

Session-3

Different types of dryers

Dr. Vivek Kumar

Department of Agricultural Engineering

School of Agricultural and Bio-Engineering

Centurion University of Technology and Management Paralakhemundi

Dist. Gajapati, Odisha 761211

- There are about 40 classes and over 100 subclasses of dryers, which are classified by different methods,
 - based on type of operation (batch, continuous),
 - type of feed (liquid, suspension, paste, granules, fibrous solids, porous solids, dense solids, and sheets),
 - heating method (convection, contact, radiation, dielectric),
 - product sensitivity (vacuum, low temperature).
- The size of dryers can be small (up to 50 kg/h), medium (50-1000 kg/h), or large (above 1000 kg/h).
- The capacity of the dryers can be expressed also as kilograms of water evaporated per unit surface and unit time, which is very high in rotary dryers (about 50 kg/m²h) and low in tray dryers (about 1 kg/m²h).

Cabinet Drying

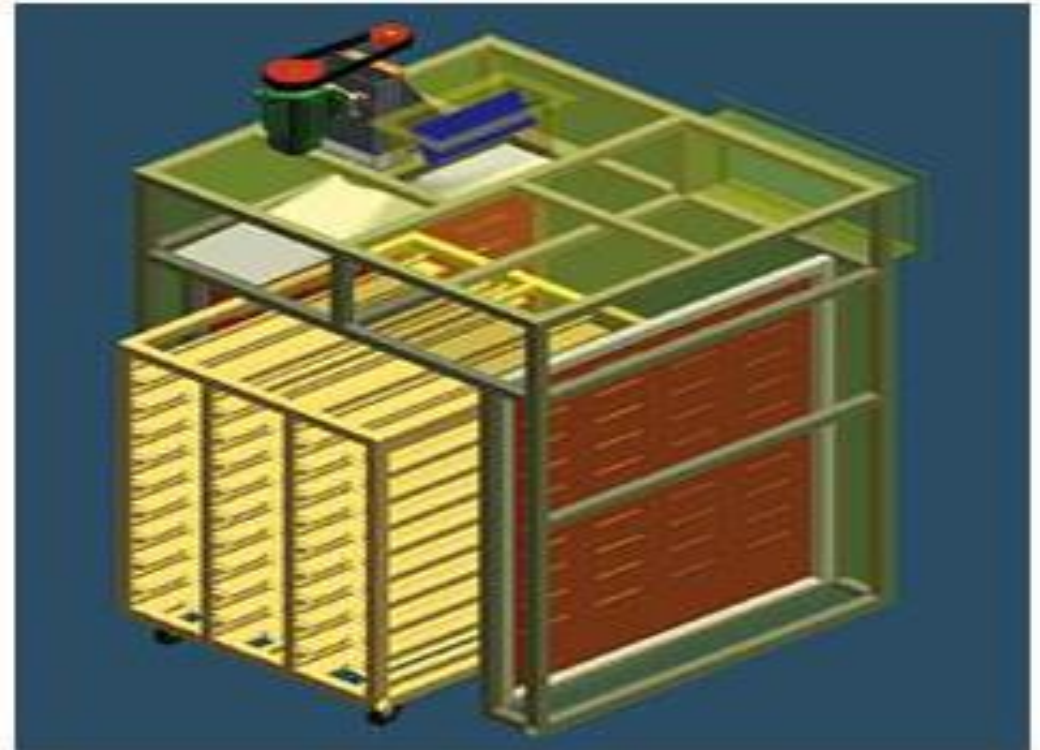
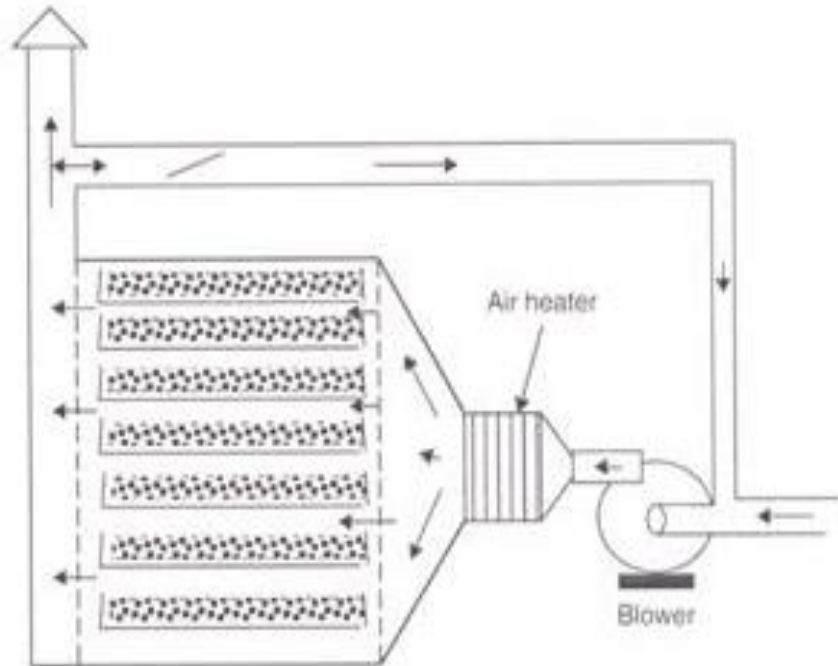
Introduction

- Used for batch drying of solid foods at small to moderate scale (Say 2000 to 20000 kg per day)
- Inexpensive and simple to construct.

Construction

- Consists of an insulated cabinet, equipped with a fan, an air heater and space occupied by trays of food.
- In Cabinet dryers, food may be loaded on trays or pans in comparatively thin layers up to a few centimetres.
- Fresh air enters the cabinet by the fan through the heater coils, and is then blown across the food trays to exhaust.
- The air is heated by the indirect method.
- Screens filter out any dust that may be in the air.
- The air passes across and between the trays in some designs, whereas some other designs have perforated trays and the air may be directed up through these.
- The air is exhausted to the atmosphere after one pass rather than being re-circulated within the system.

Cabinet dryer



- Cabinet driers are frequently found in rural installation where they are used for drying fruits, vegetables and herbs.
- Air inlet temperatures are usually in the range of 60–80°C. Air velocity is a few m.s⁻¹ and must be adjusted according to the size, shape and density of the food particles so as to avoid entrainment of dry particles with the wind.
- Depending on the product and the conditions, the duration of a batch is typically 2 to 10 hours.
- Most cabinet dryers feature means for adjustable recirculation of the air.
- The rate of recirculation is increased as drying progresses, when the air exiting the cabinet is warmer and less humid. Recirculation results in considerable saving in energy cost.

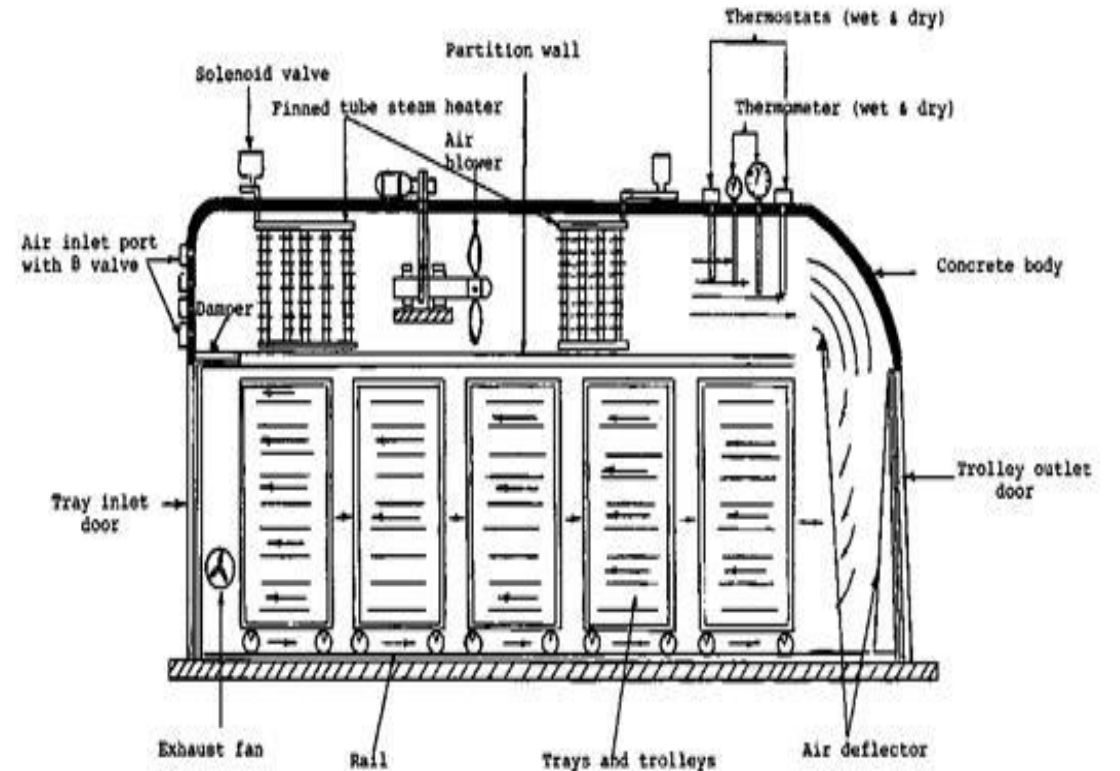
Tunnel Dryer

Tunnel dryers consist of long tunnels through which trucks carrying stacks of trays travel with or against a stream of drying air.

The material to be dried is evenly spread on the trays. Typical tray loading for wet vegetables is in the order of 10–30 kg per m².

As one truck with wet material is introduced into the tunnel at one end, another truck, carrying dehydrated product, exits at the other end. Depending on the size of the trucks and the tunnel, the trucks are moved manually or mechanically, e.g. with the help of chains.

With respect to the relative direction of movement of the air and the trucks, tunnel dryers operate in co-current, countercurrent or mixed current fashion.



Vacuum shelf indirect dryers

- Vacuum-shelf dryers are indirectly heated batch dryers similar to tray dryers. Such a dryer consists of a cabinet made of cast iron or steel plates fitted with tightly fitted doors so that it can operated under vacuum.
- Hollow shelves of steel are fastened permanently inside the chamber and are connected in parallel to inlet and outlet steam headers.
- The trays containing the solids to be dried rest upon the hollow shelves.
- The heat is conducted through the metal walls and added by radiation from the shelf above.
- The vapour usually pass to a condenser.
- These dryers are used to dry expensive or temperature sensitive or easily oxidizable materials.
- They are useful for handling materials with toxic or valuable solvents.

Rotary Dryers

- A rotary dryer consists of a hollow cylinder which is rotated and usually slightly inclined towards the outlet.
- The wet granular solids are fed at the high end as shown in the figure and move through the shell as it rotates.
- The heating shown is by direct contact with hot gases in countercurrent flow.
- In some cases the heating is by indirect contact through the heated wall of the cylinder.
- The granular particles move forward slowly a short distance before they are showered downward through the hot gases as shown in the figure.

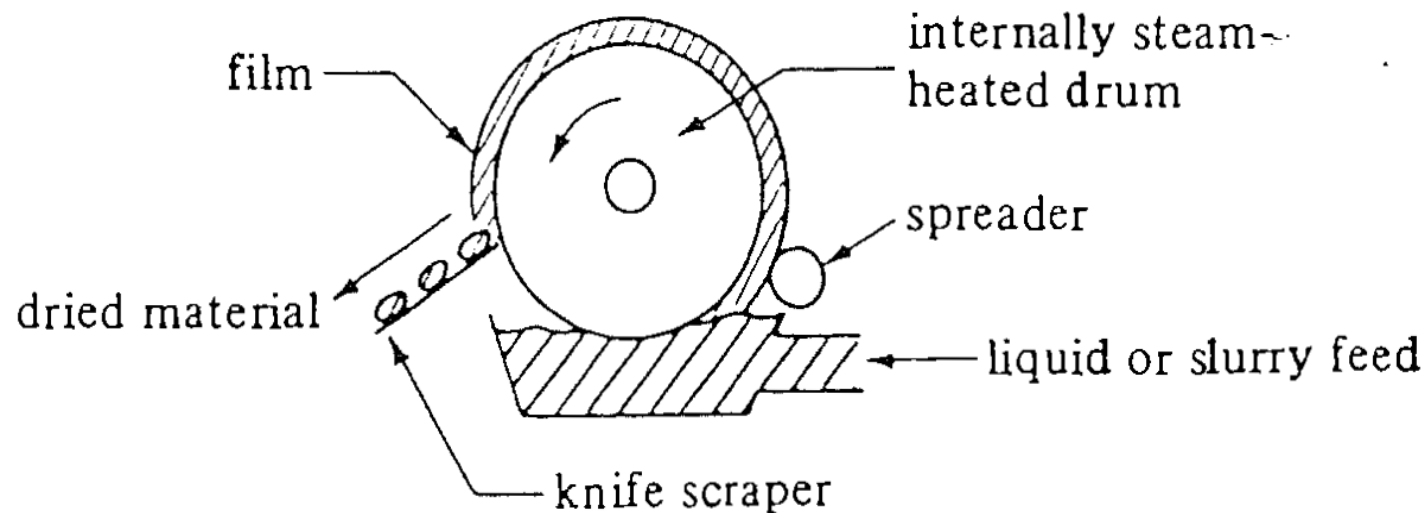
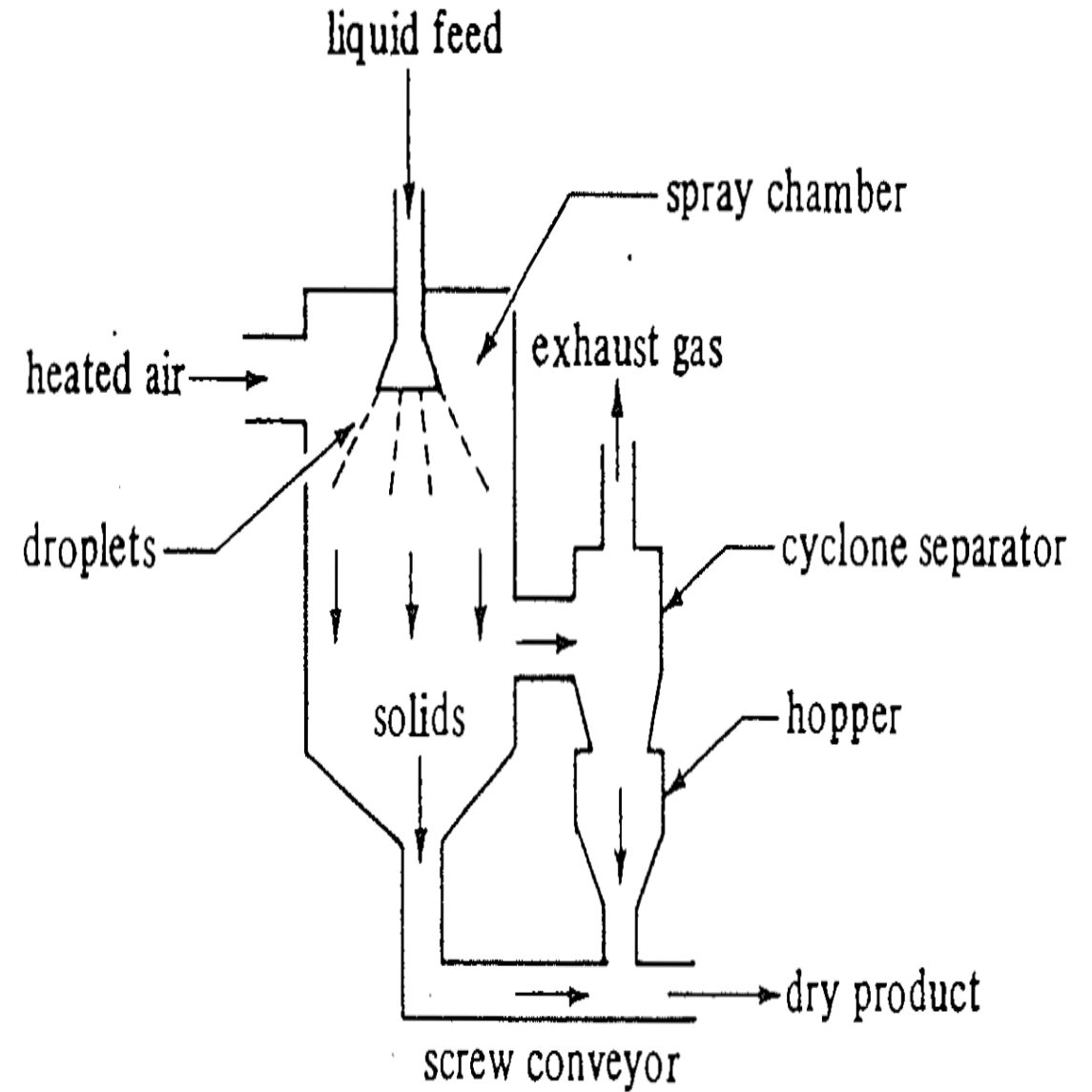


Fig. Rotary-drum dryer

Spray Dryer

- In a spray dryer a liquid or slurry solution is sprayed into a hot gas stream in the form of a mist of fine droplets.
- The water is rapidly vaporized from the droplets, leaving particles of dry solid which are separated from the gas stream.
- The flow of gas and liquid in the spray chamber may be countercurrent, concurrent or a combination.
- The fine droplets are formed from the liquid feed by spray nozzles or high speed rotating spray disks inside a cylindrical chamber



- fhhf

- fhhf

Introduction

Tunnel Drying