

Classification and selection of Dryers

Classification of Dryers

Direct contact or Indirect type dryers

Batch or continuous types

Mode of heating Conduction or convection or Infra red or dielectric dryers, Freeze dryers

Atmospheric dryers or vacuum dryers

Dryers for solids and pastes, and dryers for slurry and liquid foods.

Dryers

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graph TD; Dryers --> Direct_contact_dryers; Dryers --> Indirect_contact_dryers; Dryers --> Radiation_dryers;
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Direct contact dryers

Bin dryers
Kiln dryers
Cabinet dryers
Tunnel dryers
Conveyor dryers
Belt-trough dryers
Spray dryer,
Fluidised bed
dryers, etc.

Indirect contact dryers

Drum dryer
Rotary dryer, etc.

Radiation dryers

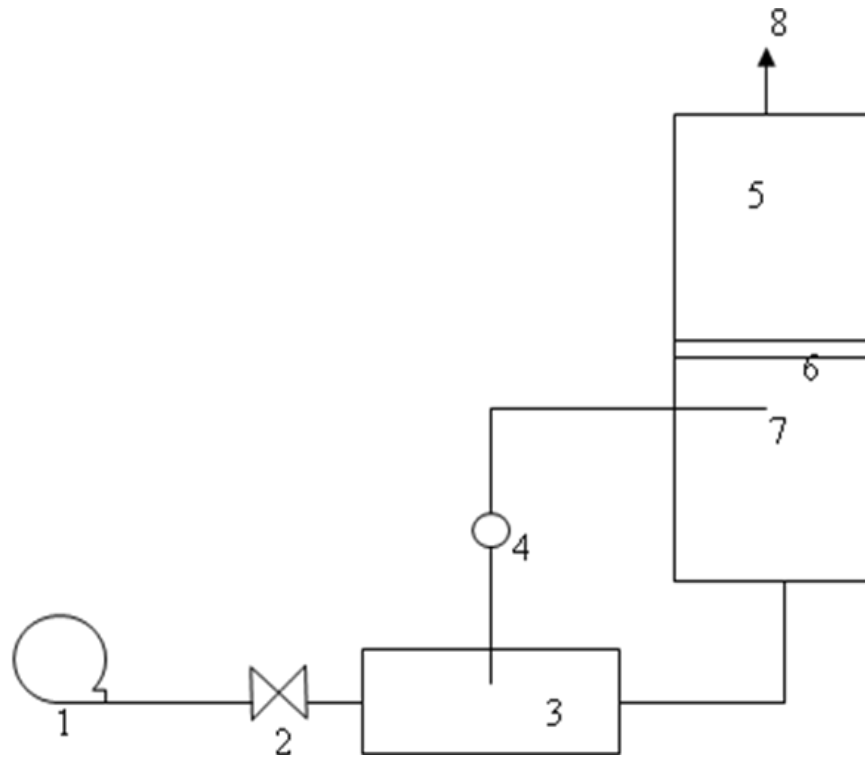
Solar dryer
Dielectric dryer
Microwave dryer
Infrared dryer,
etc.

Dryers for solids
and pastes

Different types of solar
dryers
Bin dryers
Kiln dryers
Cabinet dryers
Tunnel dryers
Conveyor dryers
Belt-trough dryers
Fluidised bed dryers, etc.

Dryers for liquid
materials

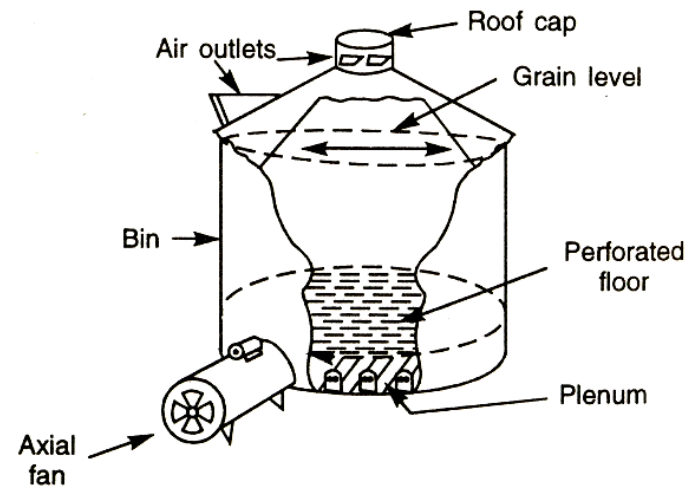
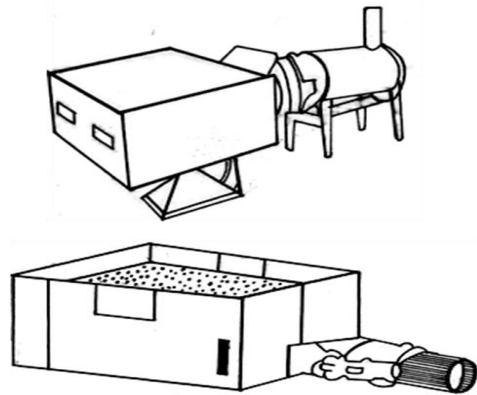
Spray dryer
Drum dryer



1 Air supply unit 2 Air flow regulating valve 3 Heating unit
4 Temperature controller 5 Drying chamber 6 Drying tray
7 Temperature sensor 8 Air exhaust

Schematic view of a dryer

Bin dryer



Bin dryer

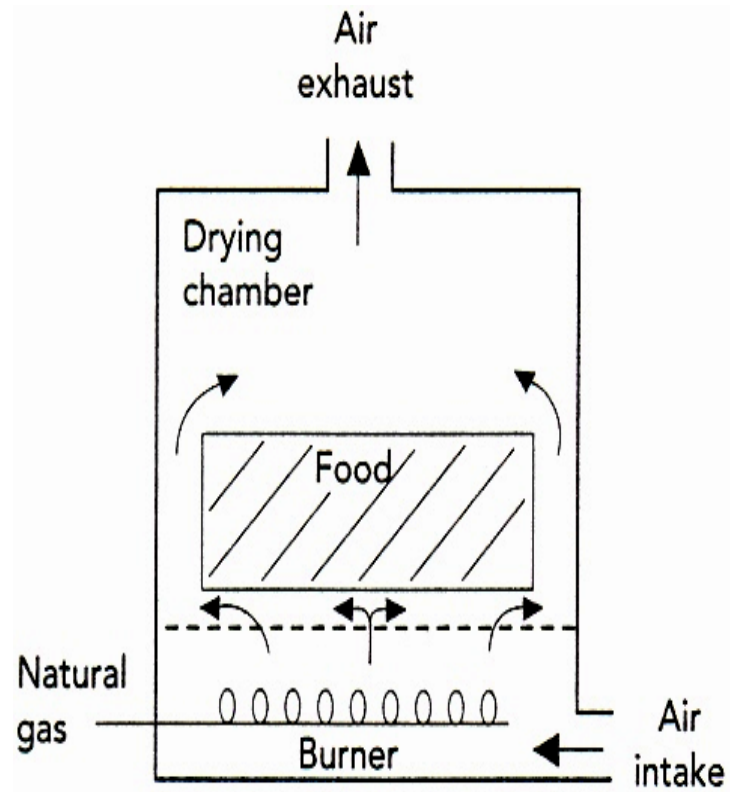
Key words:

- Modified storage bin, mesh base,
- deep bed (height up to several meters), heater,
- Low air velocity: 0.5 m/s
- high capacity
- low capital and running costs.
- Equalise variations in moisture content Smoothen fluctuations in the product flow between drying and packaging operations.

Applications:

Drying of food grains, seeds,
finishing drying of some spices (to 3-6% level)
secondary drying of a partially dry material and residual moisture not removed in a preliminary drying step is often removed during storage in this way.

Kiln dryer



Kiln dryer

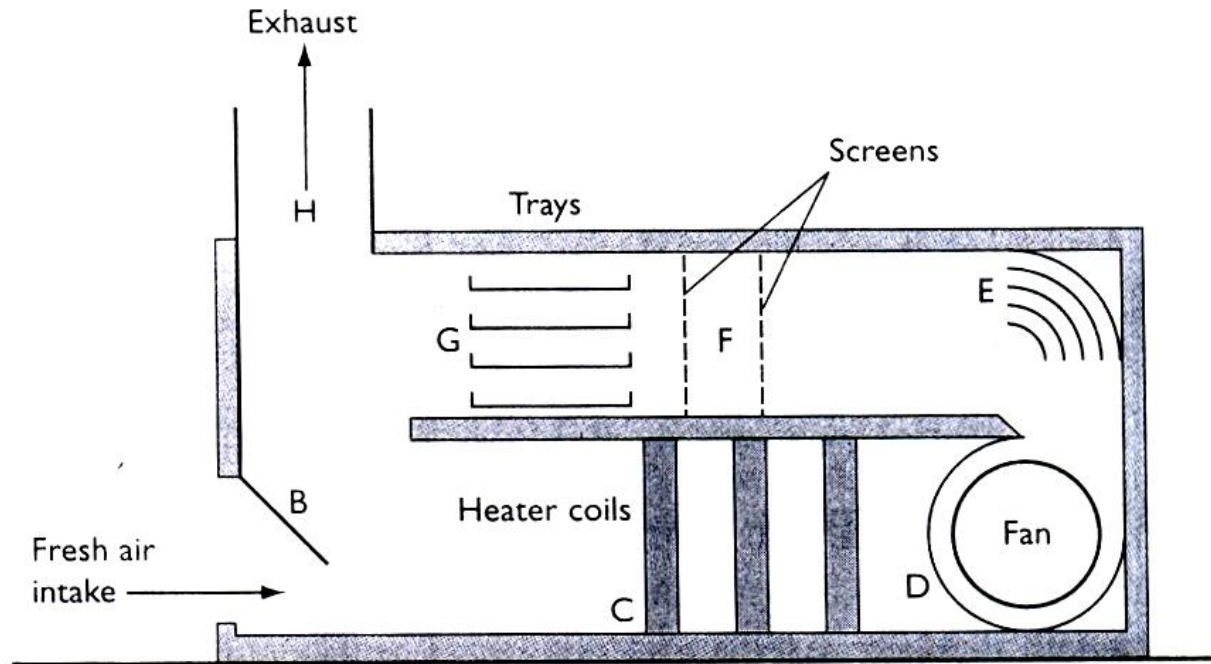
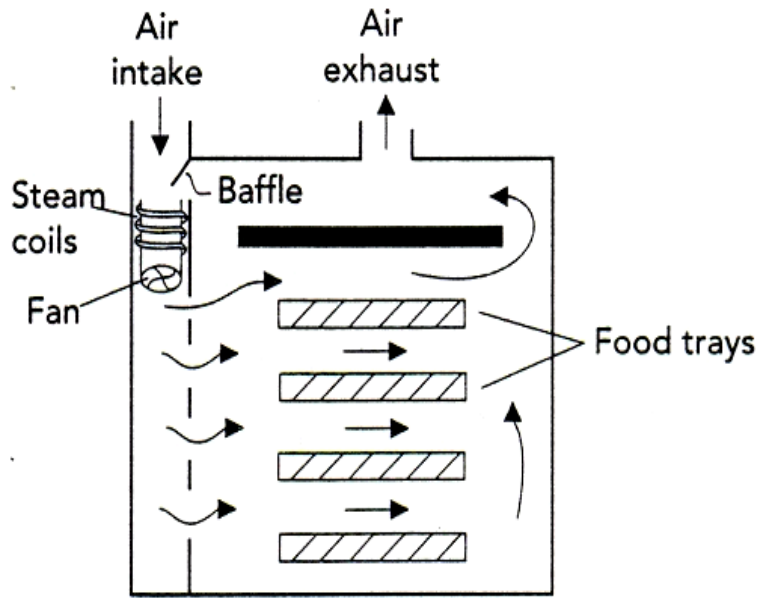
Key words:

- Two-storey building
- Bed of food up to 20 cm
- Easy construction and operation
- Low maintenance.
- High labour cost to turn the product regularly and for manual loading and unloading.
- Good heating efficiency
- Combustion products come into direct contact with the food

Applications:

- Drying of hops, malt, and some fruits

Tray dryer



Tray dryer

Key words:

- rectangular drying chamber
- depth of drying 10-100 mm
- air velocity 0.5-5 m/s
- moist air may make up fresh air
- baffles controlling flow of air to exhaust.
- product is often rotated
- low capital and maintenance cost
- flexibility of drying different types of food
- considerable labour for loading and unloading
- Uniform air circulation
- Contamination by combustion products

Applications:

- Drying of fruits and vegetables,
- foam mat drying, etc.
- For small production rates

Vacuum shelf dryer

- Modification of tray dryer
- Hollow shelves in vacuum chambers
- 1-70 Torr is maintained
- Steam or hot water in hollow shelves
- Food as thin layers on flat metal trays on hollow metal plates
- Trays may themselves contain spaces for heating fluid.
- Vacuum pump to remove vapour
- Care to prevent the dried food from burning onto trays
- Shrinkage may reduce heat conduction
- Relatively high capital and operating costs
- Low production rates
- Economics ??

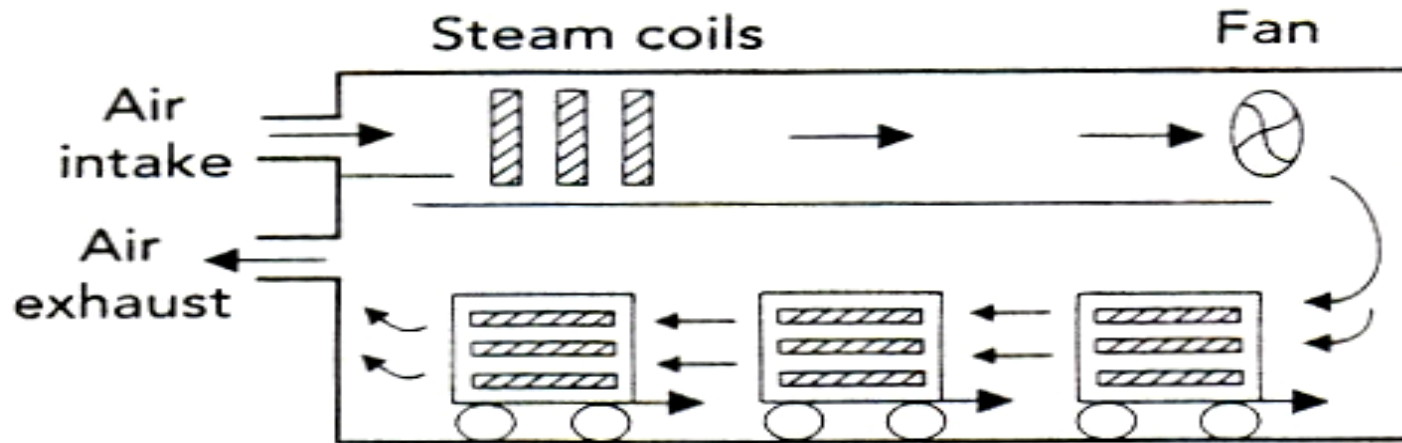
Applications:

- heat sensitive foods
- used mainly for puff drying.



Vacuum shelf dryer

Tunnel dryer



Tunnel dryer

Key words:

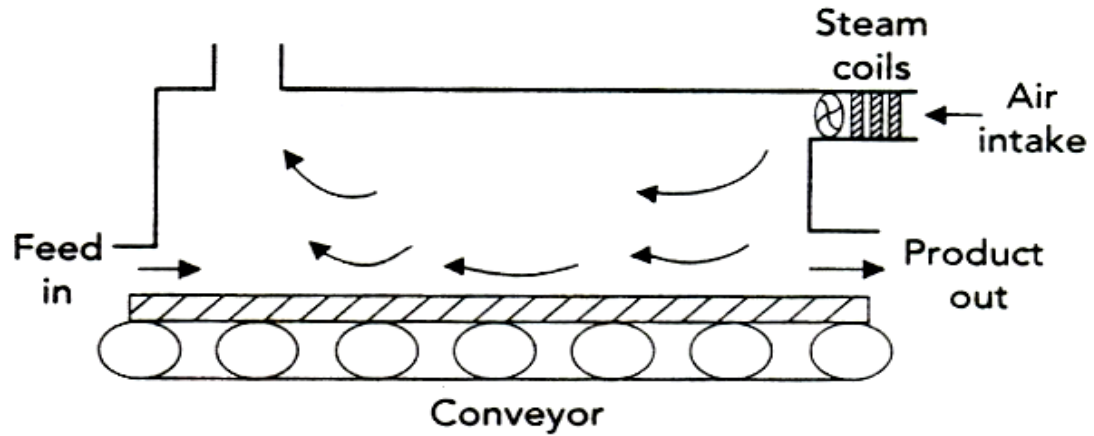
- Modified cabinet dryer having a tunnel
- Food products on trays placed in carts or trucks.
- Trucks move slowly in a semi-continuous manner
- Trucks returned to the inlet
- A 20 m tunnel contains 12-15 trucks with a total capacity of 5000 kg
- Air flow may be concurrent / countercurrent / mixed flow

Applications:

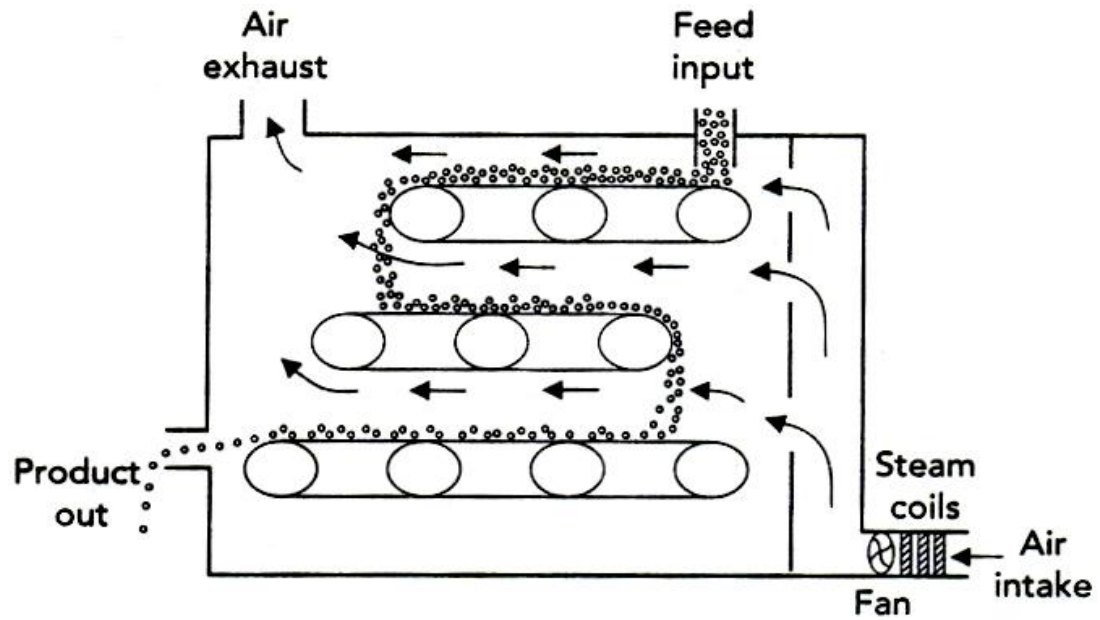
- Drying of fruits and vegetables.
- Now a days being replaced by conveyor drying or fluidised bed drying.

Conveyor dryer

(single stage)



(Multi-stage)



Conveyor dryer

Key words:

- Product on a mesh belt or conveyor (30 mesh)
- Product depth up to 15 cm
- Usually 2 m wide and 4 to 50 m long (giving residence time: 5 to 120 min)
- In ***belt trough dryers***, food is mixed and turned
- Usually operate in two stages to 50-60% moisture and then to 15-20% moisture (Final finishing in bin dryers)
- May have a series of conveyors one above the other
- Or a series of separate sections each with its own fan and air heater (variable air condn.) in the same chamber.
- The air conditions in various sections may vary. Air at the inlet end usually upward and at the discharge end in a downward direction (where material may be dusty)
- Drying of pastes and filter cakes also possible.

Pneumatic dryer

- A metal duct through which hot air conveys and dries the product
- Cyclone separator to collect the product
- Pneumatic ring dryers (continuous loop)
- High drying rates
- Close control over drying conditions
- Relatively low capital and maintenance costs
- Output can vary from 10 kg/h to 25 t/h.

High temperature short time ring dryers (or flash dryers) are special type of pneumatic dryers in which drying takes place within 2-10 seconds. Evaporative cooling of the particles prevent heat damage to high quality products.

Spray dryers can also be considered to be pneumatic dryers

Pneumatic dryer

Applications:

- Heat sensitive foods, moist powders or particulate foods
- Usually less than 40% moisture and particle size ranging from 10-500 μm .
- Flash dryers are used to expand the starch in potatoes or carrots to give a rigid, porous structure, which improve both conventional drying and rehydration ratios.

Selection of Dryer

- Physical and Chemical Properties of the product
- Production capacity (Kg/hr)
- Initial moisture content and final moisture content required
- Particle size distribution
- Temperature and drying Characteristics

Thank you