

UNIT OPERATION

unit –Vth:DRYING

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CONTENTS OF DRYING

- Definition of drying
- Importance of drying
- Difference between drying and evaporation
- Equipments
- References

INTRODUCTION OF DRYING

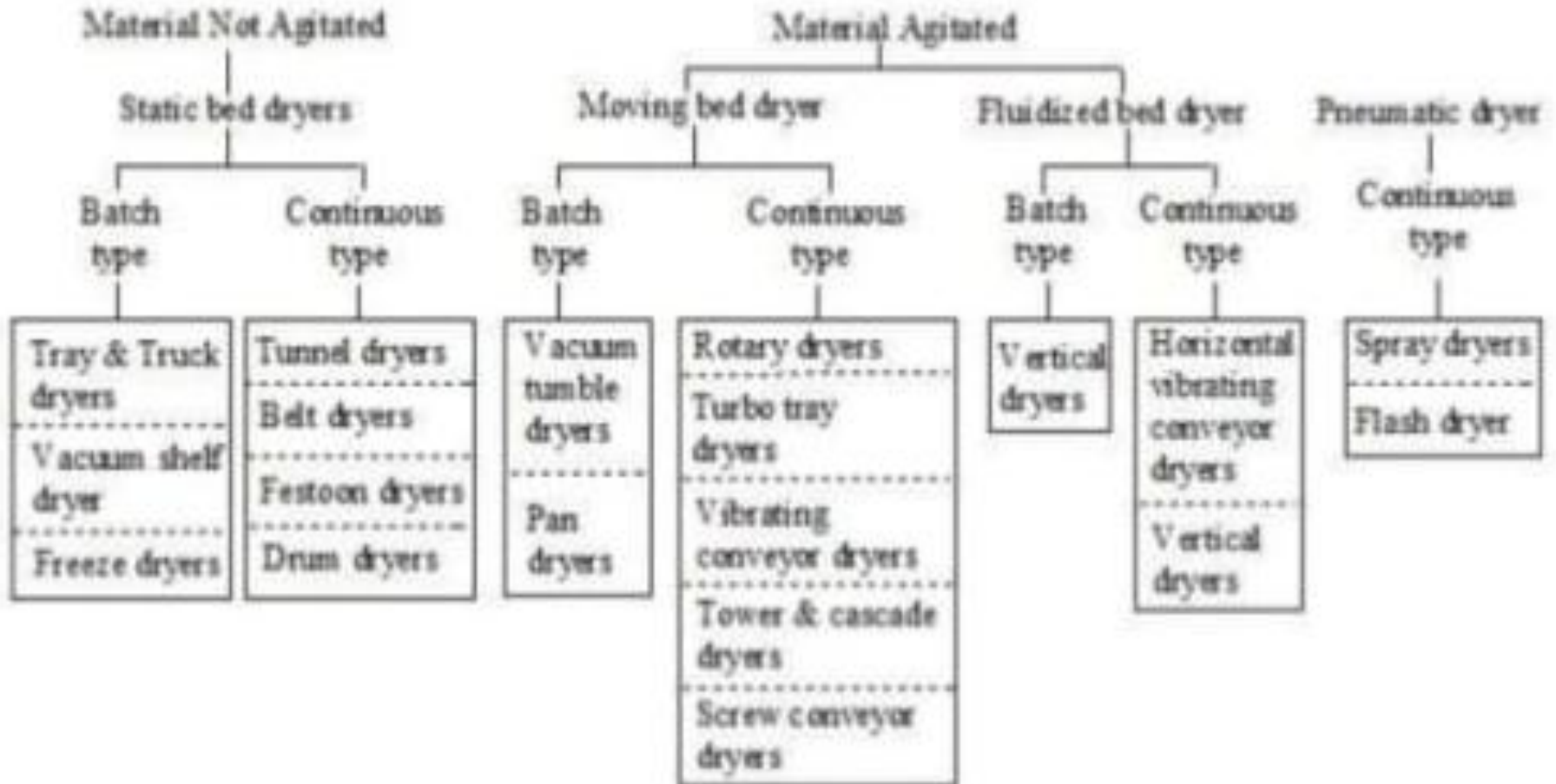
- Drying is commonly the last stage in a manufacture process.
- Drying is the final removal of water from material (usually by heat)
- **Non-thermal drying**
 - 1- As Squeezing wetted sponge
 - 2- Adsorption by desiccant (desiccation)
 - 3- Extraction.

IMPORTANCE OF DRYING

- In pharmaceutical technology, drying is carried out for one or more of the following reasons:
 1. To avoid or eliminate moisture which may lead to corrosion and decrease the product or drug stability.
 2. To improve or keep the good properties of a material, e.g. Flowability, compressibility.
 3. To reduce the cost of transportation of large volume materials (liquids).
 4. To make the material easy or more suitable for handling.
 5. Preservative.
 6. The final step in Evaporation, Filtration, Crystallization.

CLASSIFICATION OF DRYING

Classification based on solid handling



TRAY DRYER

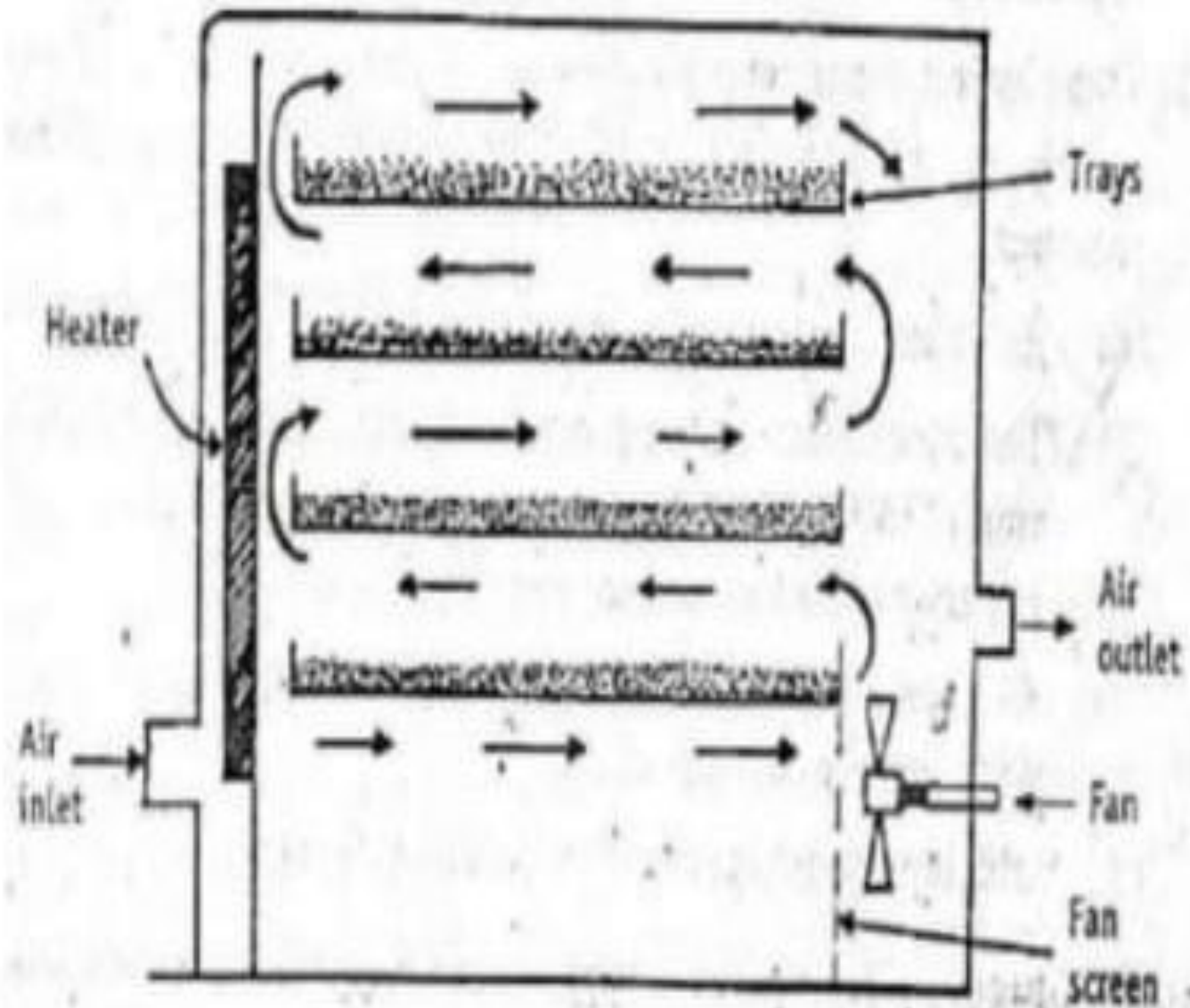
(TRAY DRYER / TRUCK DRYER / SHELF DRYER / CABINET DRYER /
COMPARTMENT DRYER)

Principal:

- Hot air- Circulation.

Construction:

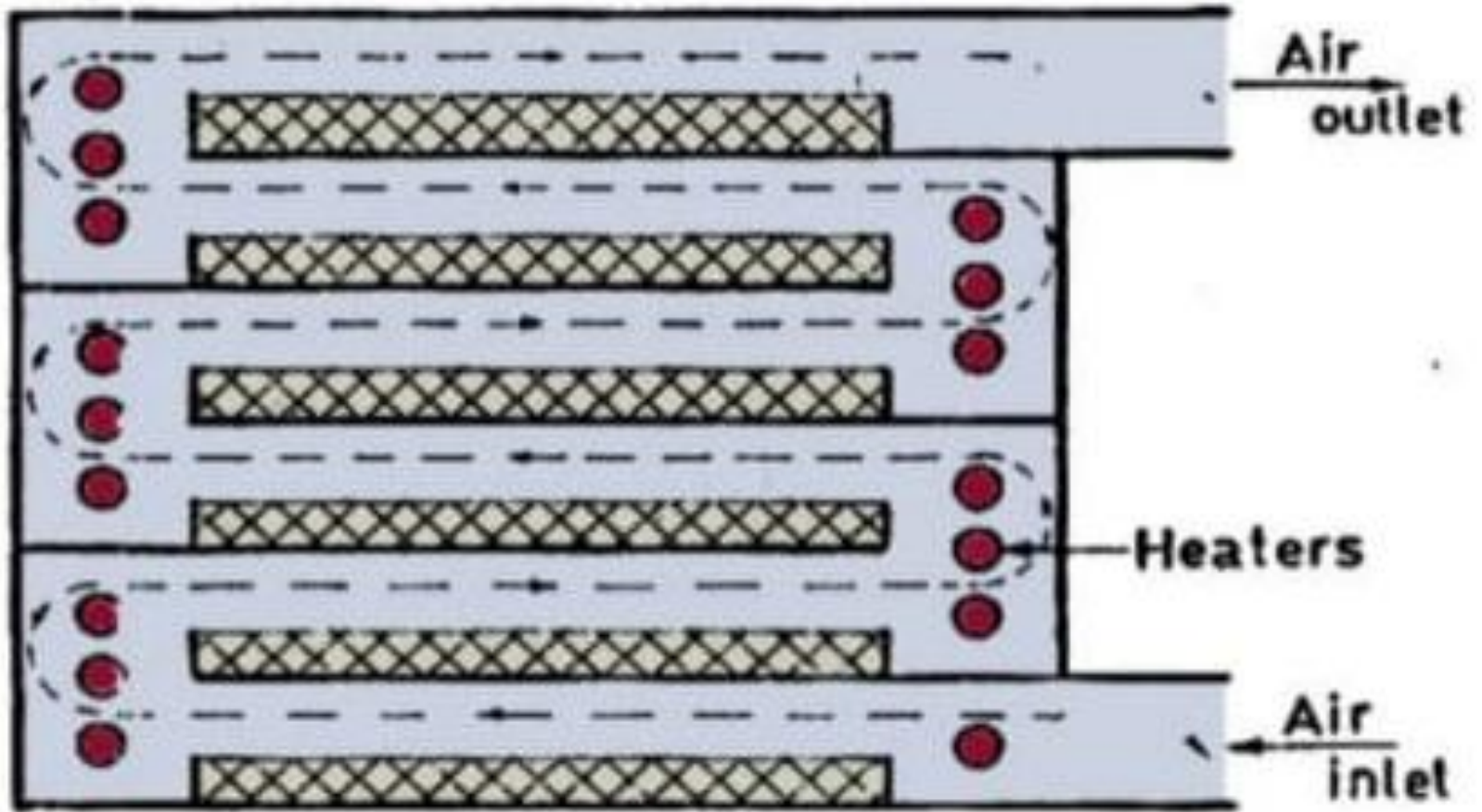
- Small or a large cabinet insulated (to reduce heat loss) compartment in which trays.
- Heater- Heating of air
- Fan: Circulate the air
- Inlet & Outlet.



TRAY DRYER

- Air flows in direction of the arrows over each shelf in turn.
- The wet material is spread on shallow trays resting on the shelves.
- Electrical elements or steam-heated pipes are positioned as shown, so that the air is periodically reheated after it has cooled by passage over the wet material on one shelf before it passes on the next.

TRAY DRYER



Directed-circulation tray drier

Working:

- Material loaded in trays- Fresh air is introduced.
- The material is heated by hot air circulated.
- The trays containing the load remain in the dryer until drying is complete,
- After which they are withdrawn, emptied and recharged for drying the next batch.

Application:

- For drying of sticky material & granular mass.
- Drying of crude drugs, chemicals, powders, tablet granules etc.

Advantages :

- Easy to operate.
- Batch process for different product.
- Can useful for drying of verity of material.

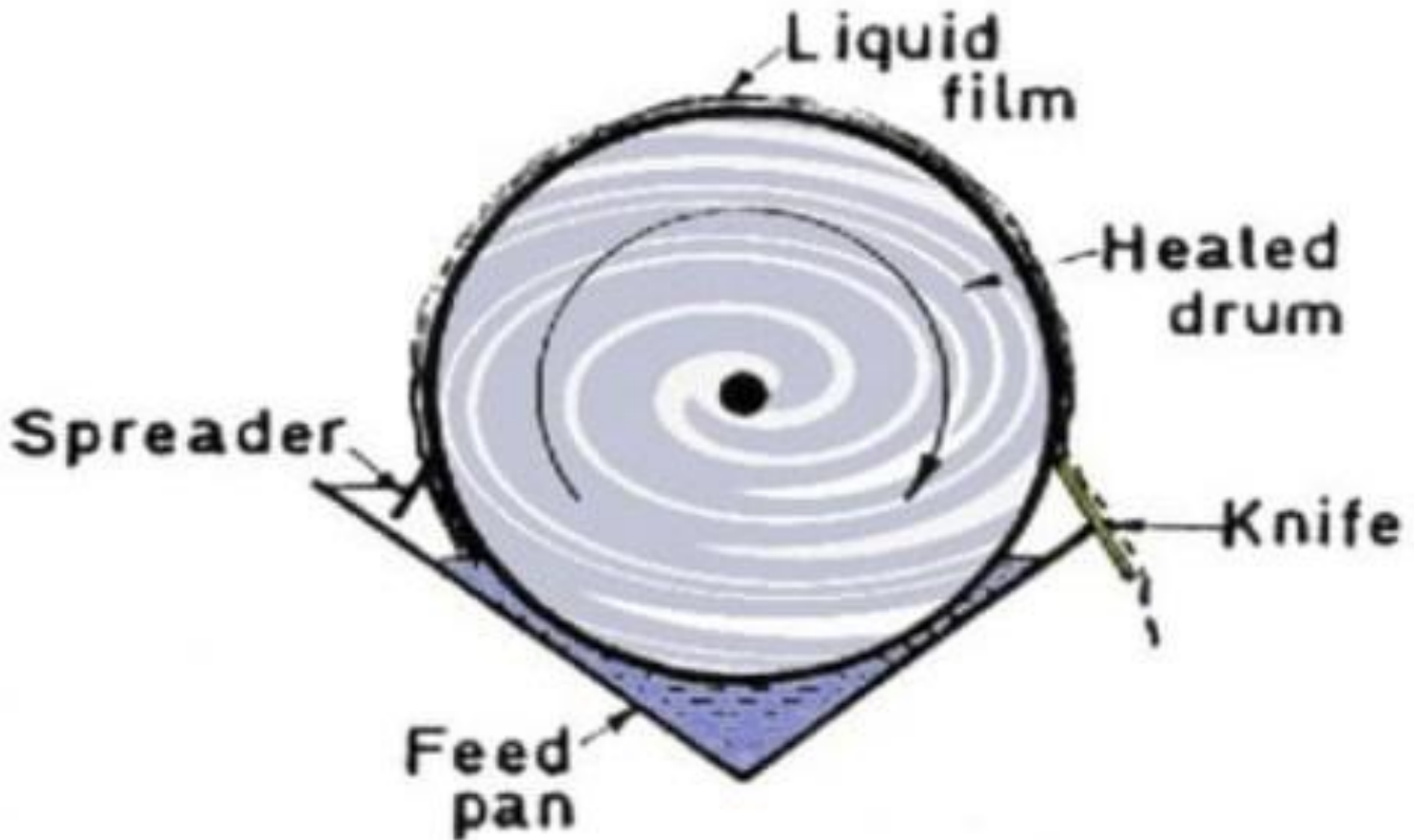
Disadvantages:

- Require labor.
- Cost increasing
- Time consuming

DRUM DRYER (FILM DRYING)

- It consists of a drum of about 0.75-1.5 m in diameter and 2-4 m in length, heated internally, usually by steam and rotated on its longitudinal axis.
- **Operation:** The liquid is applied to the surface and spread to a film, this may be done in various ways, but the simplest method *is* that shown in the diagram, where the drum dips into *a feed pan*. Drying rate is controlled by using a suitable speed of rotation and the drum temperature. The product is scraped from the surface of the drum by means of a doctor knife.

DRUM DRYER (FILM DRYING)



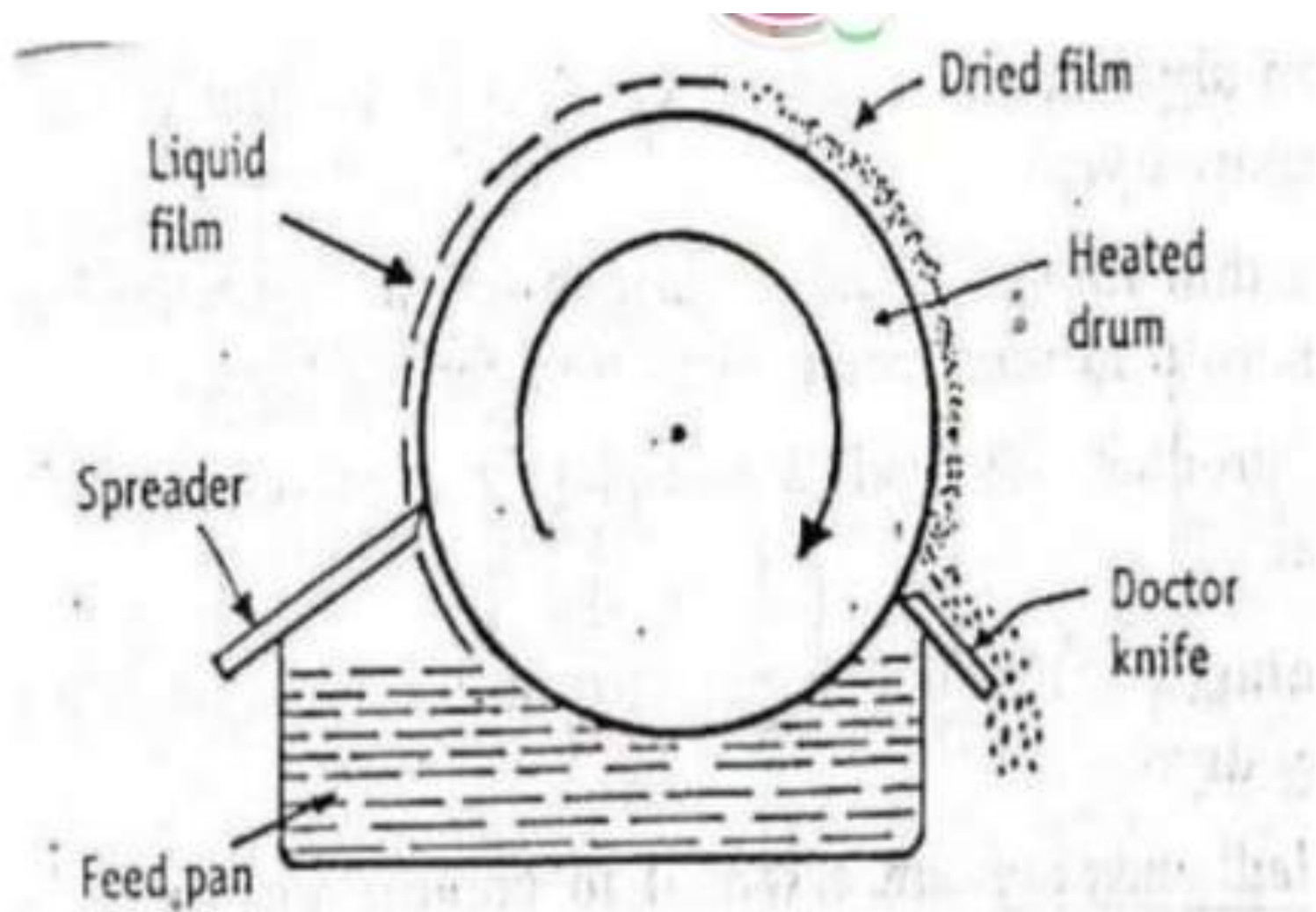
DRUM DRYER (ROLLER DRYER/FILM DRUM DRYER)

Principal:

- Material on drum & dried.

Construction:

- Hollow steel Drum
- Feed pan
- Spreader
- Doctor's knife
- Storage bin (A conveyor)



Working:

- Steam in drum- drum is rotated – through feed pan.
- Material adhere to pan- thin layer form.
- Material dry during rotation.
- Doctor's knife- Dry material is scrap –fall in storage bin.

Application:

- For drying- solutions, slurries, Suspensions, milk products, starch products, antibiotics, various substances etc,.

Advantages :

- Very rapid & continue process.
- Low labor cost.
- Gives product of uniform sphere form & fine droplet.
- Suitable for sterile products

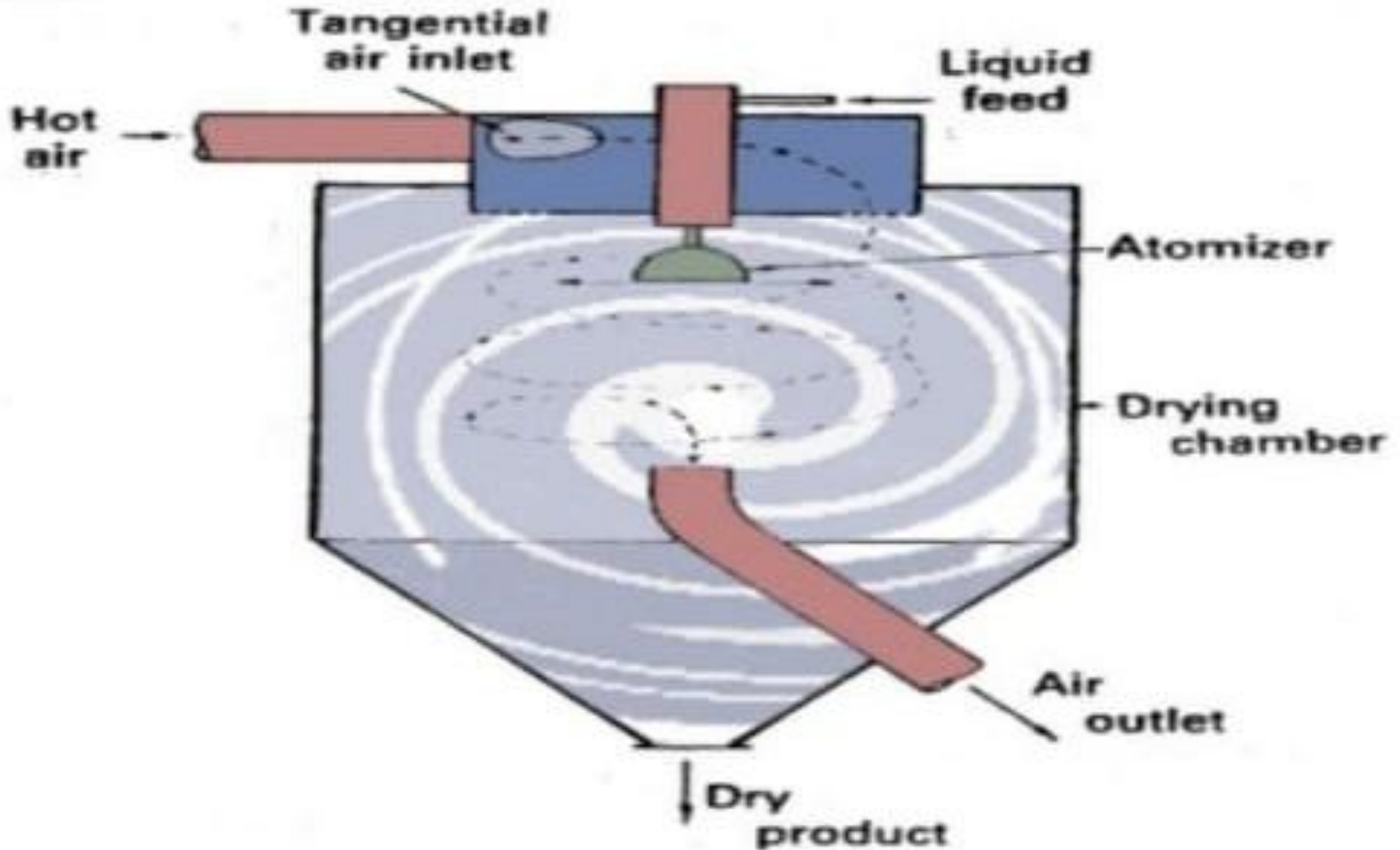
Disadvantages:

- Very bulky & expensive.
- Huge equipment (not easy to operate)
- Low thermal efficiency.

SPRAY DRYER

- The spray dryer provides a large surface area for heat and mass transfer by atomizing the liquid to small droplets.
- These are sprayed into a stream of hot air, so that each droplet dries to a solid particle.
- The drying chamber resembles the cyclone ensuring good circulation of air, to facilitate heat and mass transfer, and that dried particles are separated by the centrifugal action.
- Spray dryer can be operated efficiently at various feed rates.

SPRAY DRYER



SPRAY DRYER

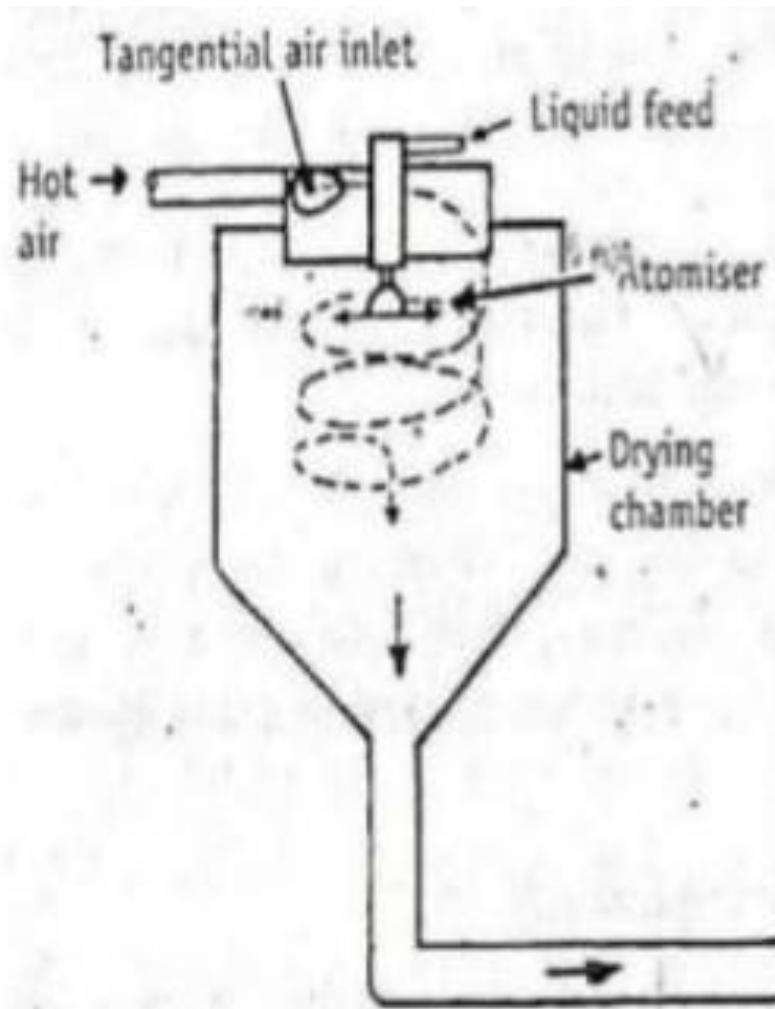
Principal:

- Material to fine droplets- moving stream of hot gas.

Construction:

- Large cylindrical drying chamber.
- Inlet of hot air & atomizer- In Roof.
- Connected to a cyclone separator.

SPRAY DRYER



Working:

1. Atomization of the liquid: Liquid feed- into chamber through atomizer.
2. Drying of liquid droplets: Due to hot air drying.
3. Recovery of dried product: Recovery in last step.

Application:

- For drying of large quantity material.
- Drying of thermo-labile, hygroscopic material.
- Drying of medicine like chloramphenicol.

Advantages :

- Suitable for heat sensitive materials.
- Compact size.
- Complete drying.

Disadvantages:

- High maintenance cost.
- Skilled operator required.
- Not suitable for less soluble salts solutions.

WORKING OF FLASH DRYER

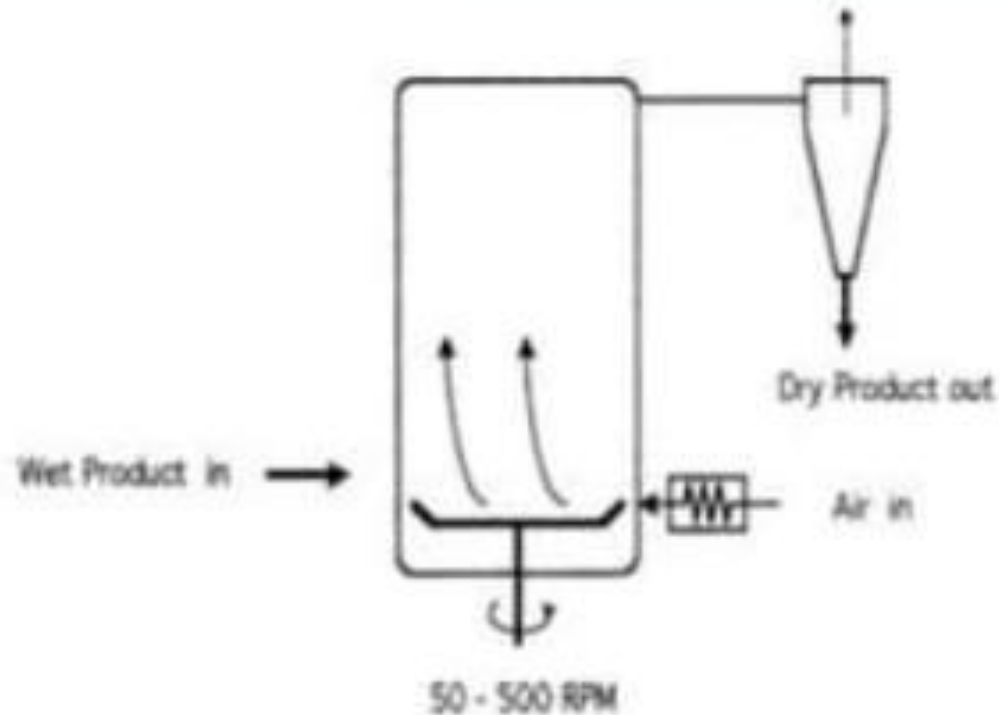
- Flash dryers utilizing superheated steam as the drying medium have some unique quality and energy advantages over air drying systems.
- Flash dryers consisting of inert media have been employed at pilot scales to dry slurries and suspensions, which are sprayed onto them.
- The particles are coated thinly by the slurry and dried rapidly as a thin film.
- Attrition due to inter-particle collisions and shrinkage induced breakage of the dried film allows entrainment of the dry powder into the drying gas for collection in a cyclone or bughouse.

The hot gas is conveying medium rapidly with velocity of order 25 m/s in which granular free flowing solid materials are dispersed.

Finely powdered wet material is introduced into hot gas (air steam) with the help of a screw conveyor.

The dried material is separated from air steam in a cyclone and bag filter. The product from the bottom of the collecting equipments (cyclone and bag filter) is transported to a silo via screw conveyor.

PNEUMATIC (FLASH) DRYER



Pneumatic (flash) dryer with centrifugal fluidizer.

PNEUMATIC DRYERS

Principle: Systems in which the drying particles are entrained and conveyed in a high velocity gas stream.

This systems further improved on fluidized bed. Ex : Spray dryer

ALL THE BEST

THANK YOU

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