

DRYING



Lab -5-

Drying

Drying

- Drying :- is the removal of liquid from material by application of heat.

It is
accomplished
by

- transfer of a liquid from a surface into an unsaturated vapor phase.

Purposes of drying:

1- Unit of process in pharmaceutical manufacturing (e.g. preparation of granules then dispense as capsules or tablets).

2- Reduce bulk and weight → lower the cost of transportation and storage.

3- Aid in preservation of animal and vegetable drugs by minimizing mold and bacterial growth in moisture laden material

4- facilitate comminution by increasing friability.

Factors affecting drying

1- Drying temperature

2- Moisture content of the sample

3- Air flow rate

4- Agitation of the sample bed

5- Layer thickness of the sample

6- Type of the material

Classification of solids on drying behavior

- 1- **Granular or crystalline solids** (water is held in shallow and open surface pores as well as in interstitial spaces between particles that are easily accessible to the surface).
- Ex: calcium sulfate, zinc oxide, magnesium oxide

- 2- **Amorphous, fibrous or gelatinous solids** (moisture is an integral part of the molecular structure as well as being physically entrapped in fine capillaries and small interior pores).
- Ex: starch, insulin and aluminum hydroxide.

Note: Amorphous solids are difficult to dry than granular or crystalline solids.

Classification of dryers based on solid handling

1- Static-bed dryers-systems

A- tray and truck dryers

B- tunnel and conveyor dryer

2- moving-bed dryers-systems

A. turbo-tray dryer

B. pan dryer

3- fluidized - bed dryers systems

4- pneumatic dryers system

5- specialized drying methods

A- Freeze dryer

B- microwave drying

1- Static-bed dryers- systems

- **A- tray and truck dryers:** it consist from cabinet in which the material dried is spread on tiers of trays .



1- Static-bed dryers- systems

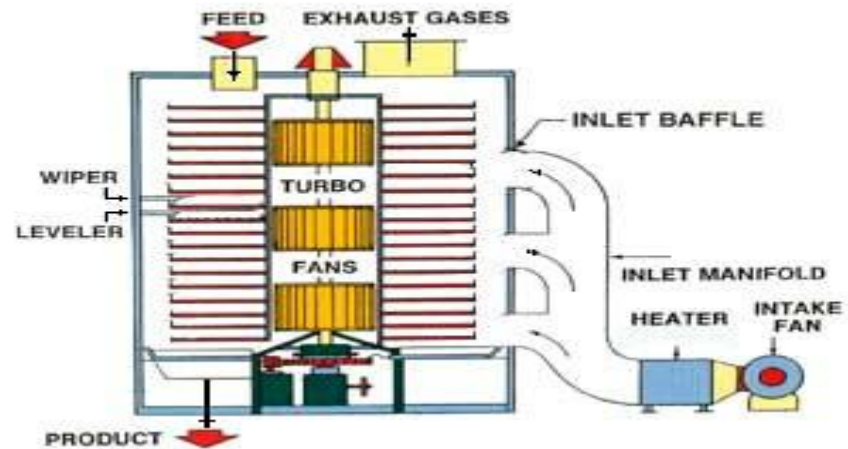
- ***B- tunnel and conveyor dryer:*** an adaptation of truck dryer for continuous drying.



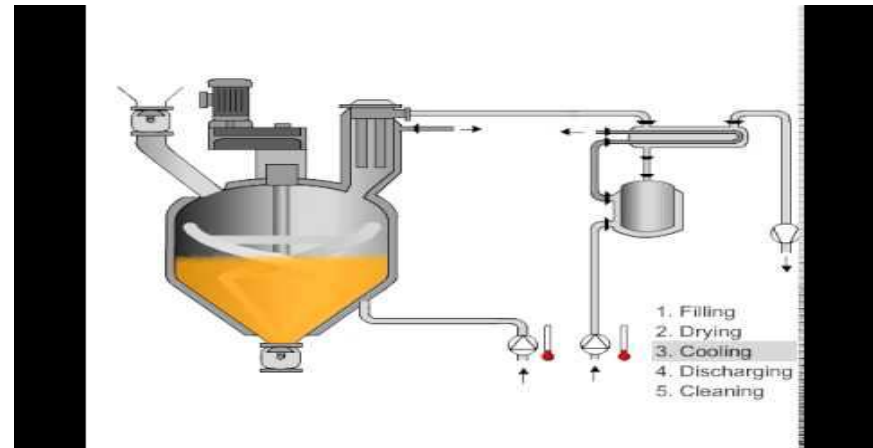
2- moving-bed dryers-systems

□ The drying particles are partially separated so that they flow over each other.

□ **A. turbo-tray dryer**

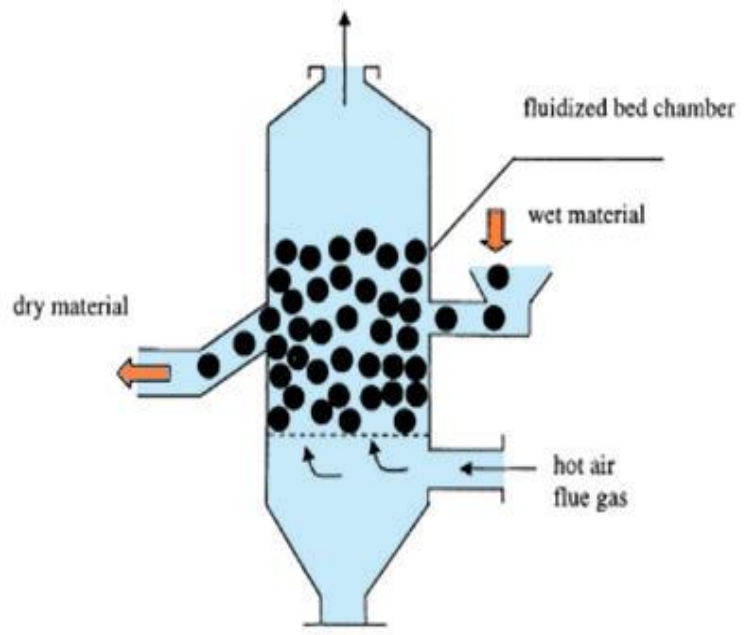


□ **B. pan dryer (generally Used for small patches of pastes and slurries)**



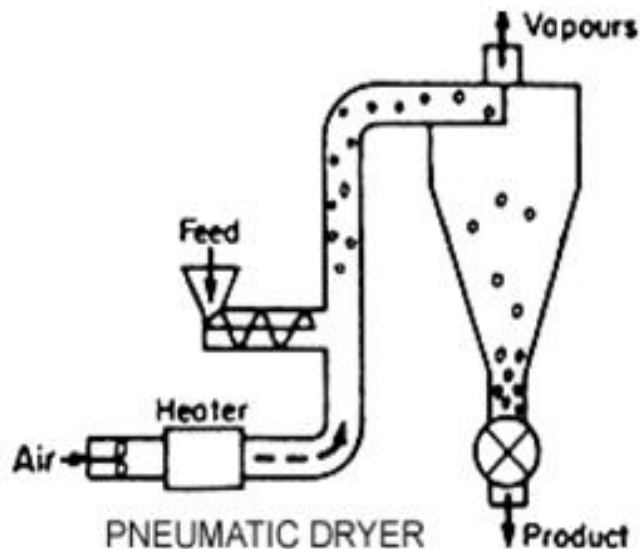
3- fluidized - bed dryers systems

- Solid particles are partially suspended in upward moving gas steam.



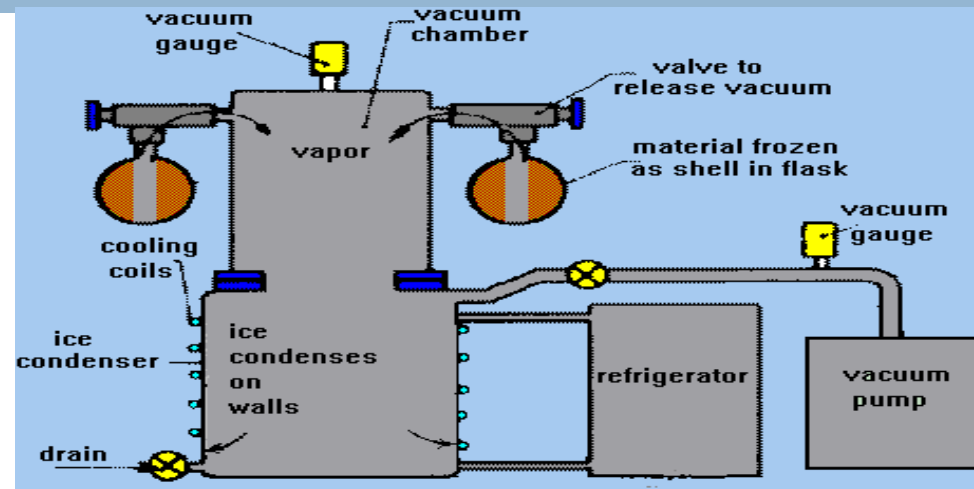
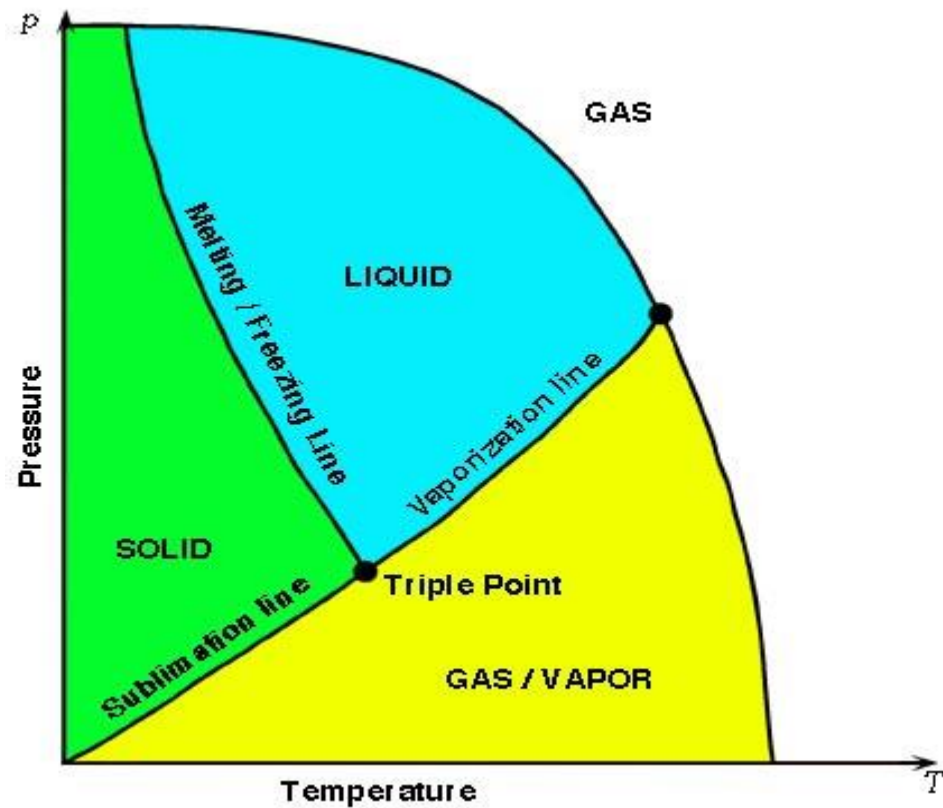
4- pneumatic dryers system

- Like spray drier, where the drying particles are entrained and conveyed in a high velocity gas stream.
- It is only used for drying of fluid materials like paste and slurries.



5- specialized drying methods

□ A- Freeze dryer



5- specialized drying methods

- **B- Microwave drying:-** here instead of applying heat externally to material, energy in form of microwaves is converted into internal heat by interaction with material itself



Solids drying

The moisture in a solid can be expressed on a **wet-weight** or **dry-weight** basis.

Wet-weight basis: loss on drying

$$\% \text{LOD} = \frac{\text{wt. of water in sample}}{\text{total wt. of wet sample}} \times 100$$

Dry-weight basis: moisture content

$$\% \text{MC} = \frac{\text{wt. of water in sample}}{\text{wt. of dry sample}} \times 100$$

Note: MC can be measured by using **moisture analyzer** or by using **oven**

Procedure

- 1- Weight a specific amount of the moist material (wet weight W_w), which depends on particle size (less weight for smaller particles) and on the moisture level (less weight for high moisture level).
- 2- Place the wet sample in oven for a certain period (until no further change in the weight is observed).
- 3- Place the dried sample in a desiccator (to reach the room temperature and avoid the absorption of atmospheric moisture).
- 4- weight the dry sample (dry weight D_w)
- 5- Calculate the %MC and % LOD using the following equations

$$\%MC = \frac{W_w - D_w}{D_w}$$

$$\%LOD = \frac{W_w - D_w}{W_w}$$

Example

If exactly 7 g of moist solid is brought to a constant dry weight of 5 g:

$$\square \%MC = \frac{W_w - D_w}{D_w}$$

$$MC = \frac{7-5}{5} \times 100 = 40\%$$

Whereas

$$\square \%LOD = \frac{W_w - D_w}{W_w}$$

$$LOD = \frac{7-5}{7} \times 100 = 28.57\%$$

For more information you can follow these links

- https://www.youtube.com/watch?v=VkVu5qDgs_Q
- <https://www.youtube.com/watch?v=MEKHkpgVZog>



thank
you