

DRYING

DEFINITION : Drying involves removal of water or another solvent by evaporation from a solid, semi-solid or liquid by application of heat and finally a liquid free solid product is obtained.

APPLICATIONS OF DRYING: 1). Preparation of bulk drugs: In the preparation of bulk drugs, drying is the final stage of processing. A few examples are – dried aluminium hydroxide, spray dried lactose and powdered extracts

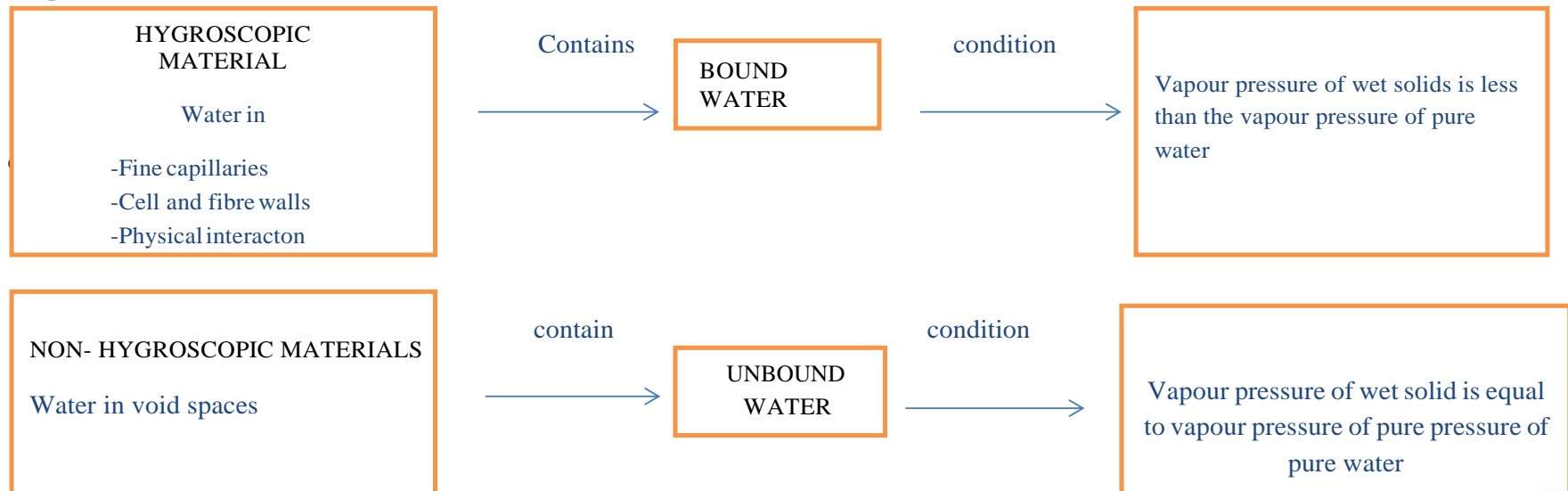
2. Preservation of drug products: Drying is necessary in order to avoid deterioration. For examples protection of blood products, skin, tissues and crude drugs from microbial growth.

3. Improved characteristics: Drying produces materials of spherical shape, uniform size, free flowing and enhanced solubility.

THEORY OF DRYING:

Bound Water: Moisture content of a substance which exerts as equilibrium vapour pressure less than of the pure liquid at the same temperature is referred to as bound moisture or bound water

Unbound Water: Moisture content of the solid which exerts an equilibrium vapour pressure equal to that of pure liquid at the given temperature is the unbound moisture or unbound water

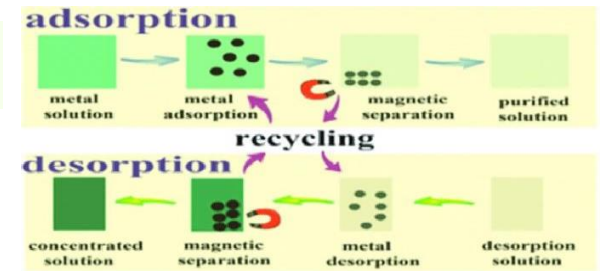


Equilibrium Moisture Content (EMC): The moisture contents of solid when it is in equilibrium with given partial pressure of vapour in gas phase is called as equilibrium moisture content. The EMC of a hygroscopic material surrounded at least partially by air is the moisture content at which the material is neither gaining nor losing moisture. The value of the EMC depends on the material and the relative humidity and temperature of the air with which it is in contact. Critical Moisture Content

Desorption: The process of removal of an adsorbed substance from a surface on which it is absorbed is called desorption.

Sorption: If solid contains less moisture than EMC of solid will be continuously absorb

Water until EMC is reached. This process is called as sorption



MEASUREMENT OF EMC :

Application: 1) The EMC curve permits the selection of the experimental condition to be used for drying the product. Drying should be stopped when the moisture content reaches the level of the EMC under the exposed condition. Over-drying can be avoided, because over-dried solid quickly regains the moisture from the ambient condition

Free Moisture Content (FMC): The moisture content of solid in excess of the equilibrium moisture content is referred to as free moisture. During drying, only free moisture can be evaporated. The free moisture content of a solid depends upon the vapour concentration in the gas.

Rate Relationships: $\% \text{ Moisture content} = \frac{\text{Weight of water in sample}}{\text{Weight of dry sample}} \times 100$

Rate of Drying: $\text{Drying Rate} = \frac{\text{Weight of water in sample (kg)}}{\text{Time (h)} \times \text{Weight of dry solid (kg)}}$

$$\text{Loss on Drying} = \text{Loss on drying (\%)} = \frac{\text{Mass of water in sample (kg)}}{\text{Total mass of wet sample (kg)}} * 100$$

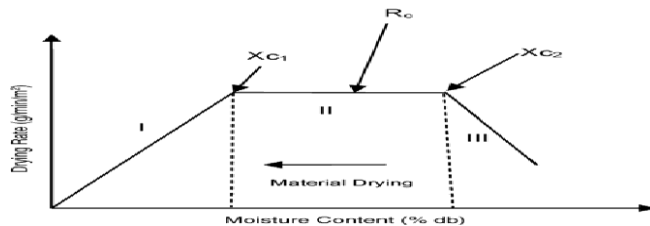


fig no : FMC CURVE

CLASSIFIATION OF DRYING EQUIPMENT:

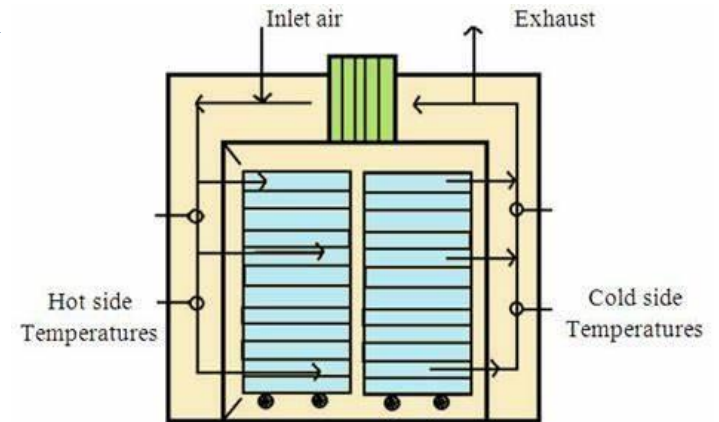
TRAY DRYER:

Principle : The basic working principle of this incredible machine is the continuous circulation of hot air. In the tray dryer, moisture is removed from the solids that are placed in the tray by a forced convectional heating. The moist air is removed is partially but in a simultaneous fashion .

Working : 1) In tray dryer hot air is continuously circulated. Forced convection heating takes place to remove moisture from the solids placed in trays.

2) Simultaneously the moist air is removed partially.

3) Wet solid is loaded in to the trays. Trays are placed in the chamber



- 4) Fresh air is introduced through inlet, which passes through the heaters and gets heated up.
- 5) The hot air is circulated by means of fans at 2 to 5 metre per second.
- 5) Turbulent flow lowers the partial vapour pressure in the atmosphere and also reduces the thickness of the air boundary layer.
- 6) The water is picked up by the air. As the water evaporates from the surface, the water diffuses from the interior of the solids by the capillary action.
- 7) These events occur in a single pass of air. The time of contact is short and amount of water picked up in a single pass is small.
- 8) Therefore, the discharged air to the tune of 80 to 90 % is circulated back through the fans. Only 10 to 20% of fresh air is introduced.
- 9) Moist air is discharged through outlet. Thus, constant temperature and uniform air flow over the materials can be maintained for achieving uniform drying.
- 10) In case of the wet granules as in tablets and capsules drying is continued until the desired moisture content is obtained.
- 11) At the end of the drying trays or trucks are pulled out of the chamber and taken to a tray dumping station.
of hot air.

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ACADEMIC YEAR:-2021-2022