

PROTECTED CULTIVATION AND
POST HARVEST TECHNOLOGY
(ASAE3204)
DRYING THEORY

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OBJECTIVE OF DRYING

- It preserve perishable products against spoilage by reducing water activity.
- Permits continuous supply of product through out the year
- It increases shelf life of products.
- To reduce cost and difficulty of packaging, handling, transportation and storage.

DRYING THEORY

- It is the removal of moisture content to a recommended level due to difference in vapor pressure between the product and atmosphere.
- Dry matter of the commodity remains constant.
- Hygroscopic material enter into falling rate period faster than non-hygroscopic material.
- The moisture content of substance is expressed by two methods:

MC_{w.b} and MC_{d.b}

- Generally moisture content is measured in wet basis for industrial purpose.
- For plotting drying curves moisture content dry basis is used.
- Moisture content dry basis is always greater than moisture content wet basis.

$$M_w(\text{wet basis}) = \frac{w - d}{w} \times 100$$

$$M_d(\text{dry basis}) = \frac{w - d}{d} \times 100$$

MOISTURE CONTENT DETERMINATION METHODS

1. DIRECT METHODS :

- a. Hot air oven method
- b. Vacuum oven method
- c. Balance

2. INDIRECT METHODS :

- a. Electrical resistance method
- b. Dielectric method
- c. Chemical method

EQUILIBRIUM MOISTURE CONTENT-EMC

- It is the final moisture content attained by the hygroscopic product.
- The grain will gain moisture if the outside vapor pressure is higher and will lose moisture if outside vapor pressure is lower than the vapor pressure of grain moisture.
- The moisture content attained by the grain with respect to a set of atmospheric temperature and RH such that the grain moisture is in equilibrium with the surrounding air is called EMC of the product.

- EMC is generally expressed in dry basis.
- If the air is having 0 % humidity then $EMC = 0$.
- The difference between the EMC at desorption and adsorption process is due to hysteresis effect.

FACTORS AFFECTING EMC:

1. Type of product
2. Variety of product
3. Maturity
4. Temperature and RH of surrounding air

**It can be calculated using
Henderson's equation:**

EMC can be calculated using Henderson's equation

$$1 - RH = \exp(-c.T.M^n)$$

Where

RH= relative humidity in decimal

C, n= constants

T= temperature in kelvin

M= EMC

NUMERICAL

- Calculate the EMC of brinjal seed at RH of 10% and temperature of 50°C using Henderson's equation. Given that constant c is 6.5×10^{-6} and n is 1.8.

TYPES OF MOISTURE:

1. **Free moisture**

The moisture that is present in excess of equilibrium moisture is known as free moisture.

It is the difference between the initial moisture content and EMC under given drying conditions.

2. **Bound moisture**

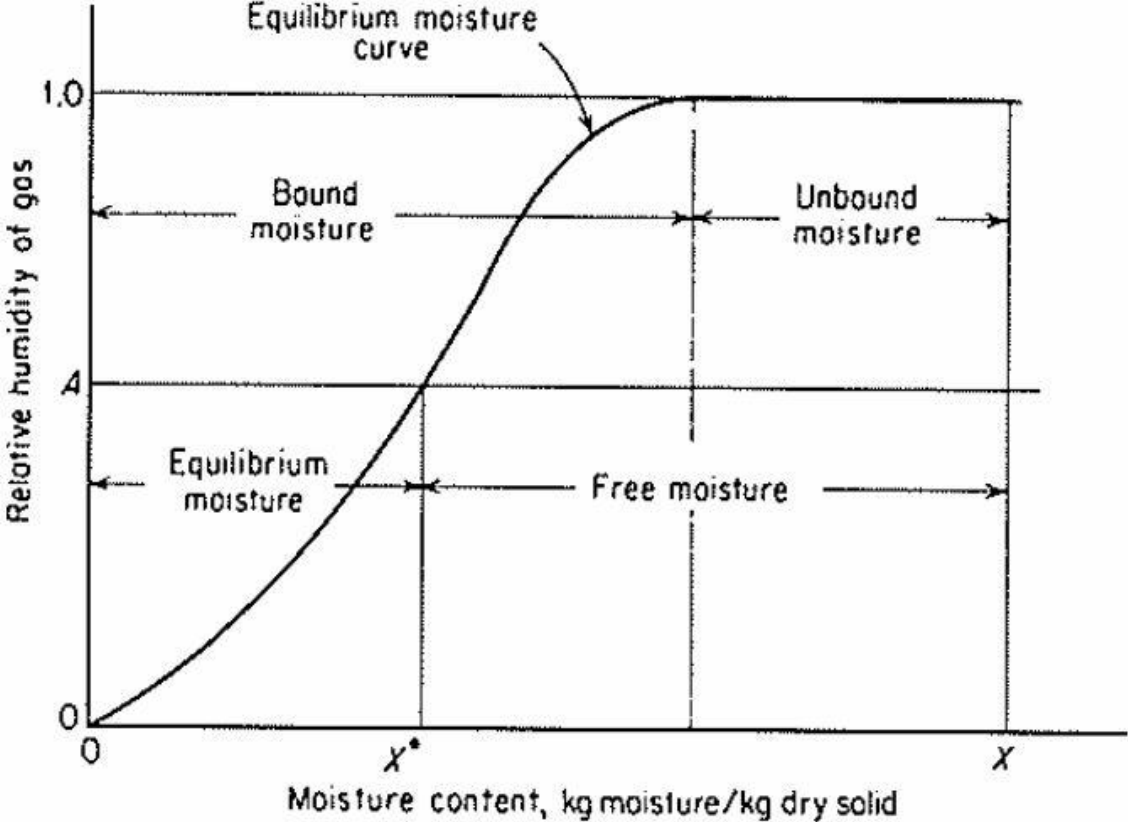
it is the equilibrium moisture of a product at 100% RH.

3. **Unbound moisture**

the moisture present in product in excess of bound moisture is called as unbound moisture.

It is generally held in void spaces of solid.

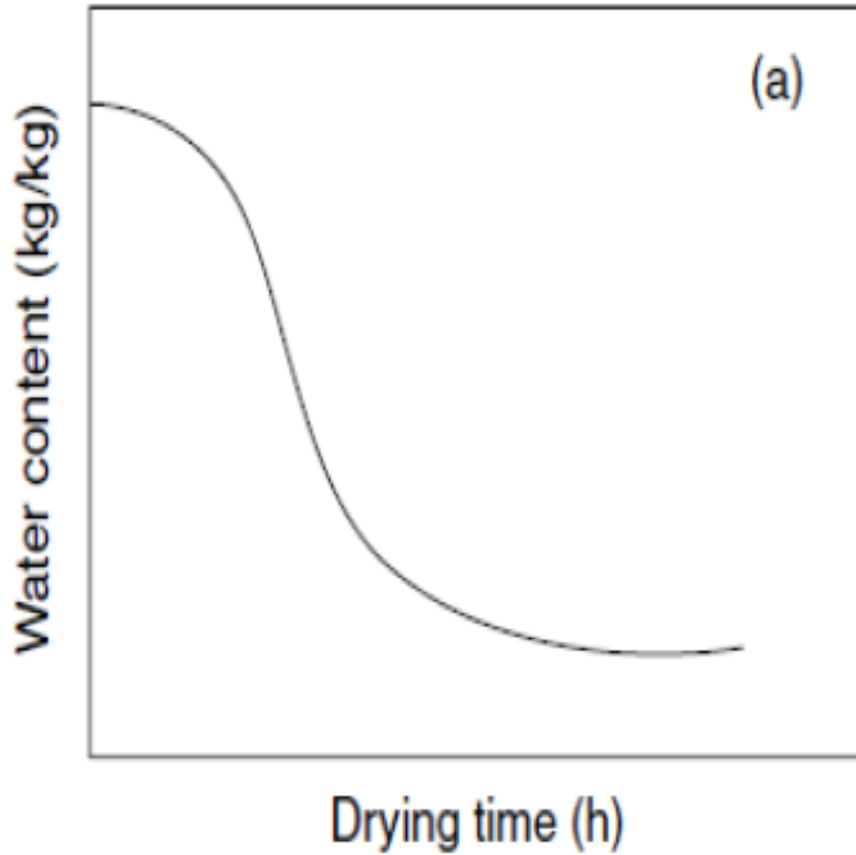
Types of Moisture



RATE OF DRYING

- The rate of drying of moisture content is expressed as the amount of moisture removal per unit time per unit weight of dry matter/ per unit drying surface area.
 - a. Constant rate period of drying
 - b. Falling rate period of drying
- Falling rate period is of two types depending upon the nature of product i.e. 1st falling rate and 2nd falling rate.
- The moisture content at which the constant rate period changes to falling rate period is known as critical moisture content.
- The moisture content at which falling rate period ends is known as the EMC.

DRYING CURVES



FIG(I)

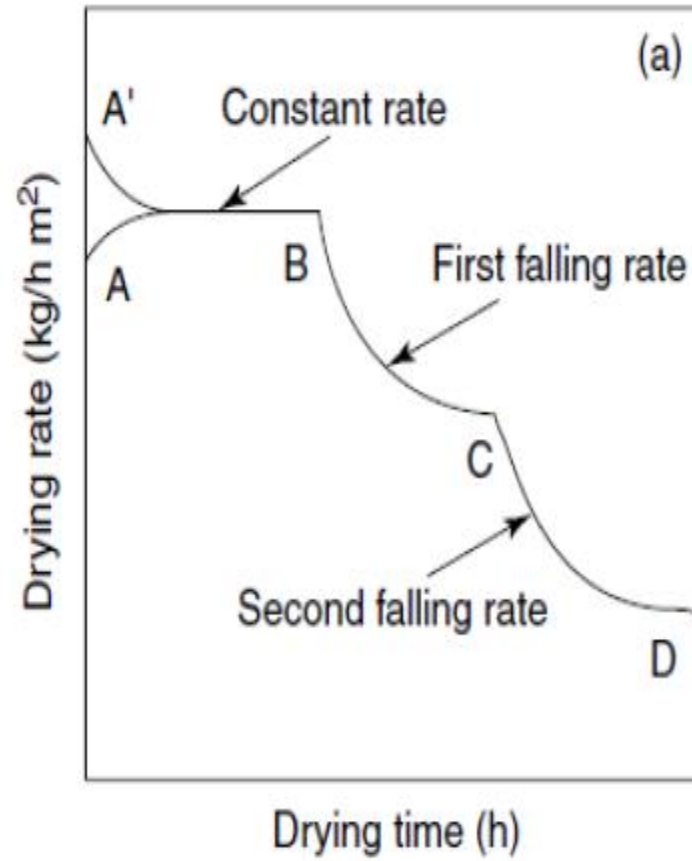
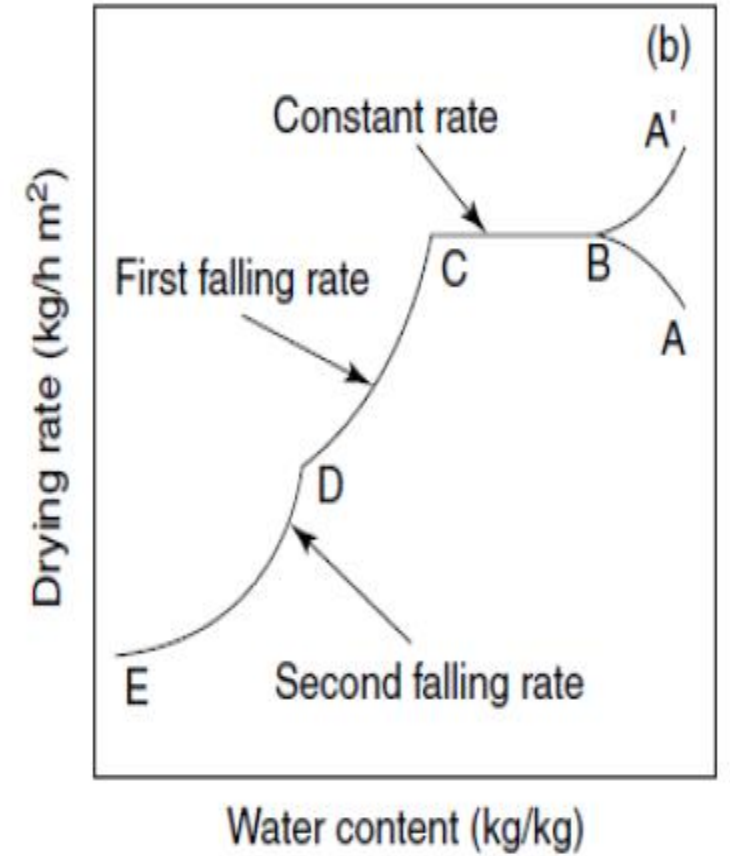


FIG (II)



FIG(III)

THANK YOU