



## In-Class Exercises n°02

### Exercise 2.1 –

Two tons of paddy with **22% moisture content on wet basis** is to be dried to **13% moisture content on (db)**. Calculate the weight of bone dry products and water evaporated.

### Exercise 2.2 –

Determine the quantity of parboiled paddy with **40% moisture content on a wet basis** required to produce 1 ton of product with **12% moisture content on a wet basis**. Work out the problem on wet basis and check the answer using dry basis.

### Exercise 2.3 –

**500 kg** of paddy at **22% moisture content (wb)** is dried to **14% moisture content (wb)** for milling. Calculate the amount of moisture removed in drying.

### Exercise 2.4 –

A wet solid containing **40% moisture (wet basis)** is dried to **10% moisture (wet basis)**. Feed rate: **100 kg/h wet solid**. Determine water removed per hour.

### Exercise 2.5 –

A wet solid is dried in a laboratory tray dryer. Only the upper surface is exposed to the drying air. The mass of the sample is recorded at different times. After complete drying, the mass of dry solid is found to be **0.80 kg**. The exposed drying area is **0.25 m<sup>2</sup>**. The equilibrium moisture content under the operating conditions is **X<sub>e</sub> = 0.02 kg H<sub>2</sub>O/kg dry solid**.

The experimental data are given below:

Time (min)	Mass of sample (kg)
0	1.28
10	1.18
20	1.10
30	1.03
45	0.95
60	0.90
90	0.85



### Questions

- Calculate the moisture content  $X_t$  (dry basis) at each time.
- Determine the free moisture content  $X$  at each time.
- Plot the curve of free moisture content versus time.
- Using the graphical method, estimate the drying rate at  $t = 20$  min and  $t = 60$  min.
- Plot the drying rate versus free moisture content and identify the drying regimes (constant-rate and falling-rate periods).

### Exercise 2.6 –

A wet porous solid is dried in a tray dryer under constant operating conditions. The drying process exhibits a constant-rate period followed by a falling-rate period. During the falling-rate period, the drying rate is assumed to decrease linearly with the moisture content.

The following data are available:

- Mass of dry solid: **80 kg (dry basis)**
- Effective drying surface area: **16 m<sup>2</sup>**
- Initial moisture content: **0.60 kg H<sub>2</sub>O/kg dry solid**
- Critical moisture content: **0.25 kg H<sub>2</sub>O/kg dry solid**
- Final moisture content: **0.08 kg H<sub>2</sub>O/kg dry solid**
- Equilibrium moisture content: **0.03 kg H<sub>2</sub>O/kg dry solid**
- Constant drying rate: **1.0 kg·h<sup>-1</sup>·m<sup>-2</sup>**

**Questions:** Assume steady operating conditions and neglect heat losses.

- Calculate the time required for drying during the constant-rate period.
- Calculate the time required for drying during the falling-rate period.
- Determine the total drying time.
- Calculate the percentage of the total drying time that occurs in the falling-rate period.

### Exercise 2.7 –

A wet solid is dried from an initial moisture content of  $X_1 = 0.4$  kg water/kg dry solid to a final moisture content  $X_2 = 0.05$  kg water/kg dry solid. The critical moisture content is  $X_c = 0.15$  kg water/kg dry solid.



The constant drying rate is  $R = 1.0 \text{ kg water/h.m}^2$ . The dry solid mass per unit area is  $m_s = 10 \text{ kg dry solid/m}^2$ . The falling rate is linear, passing through the origin. **Calculate** the total drying time.

### Exercise 2.8 –

The initial moisture content of a food product is **77% (wet basis)**, and the critical moisture content is **30% (wet basis)**. If the constant drying rate is **0.1 kg H<sub>2</sub>O / m<sup>2</sup>·s**, **compute** the time required for the product to begin the falling rate drying period. The product has a cube shape with **5 cm** sides, and the initial product density is **950 kg/m<sup>3</sup>**.

### Exercise 2.9 –

A cabinet dryer is being used to dry a feed product from **68% moisture content (wet basis)** to **5.5% moisture content (wet basis)**. The drying air enters the system at **54°C** and **10% RH**. The product temperature is **25°C** throughout drying.

**Compute** the quantity of air required for drying on the basis of **1 kg** of product solid.