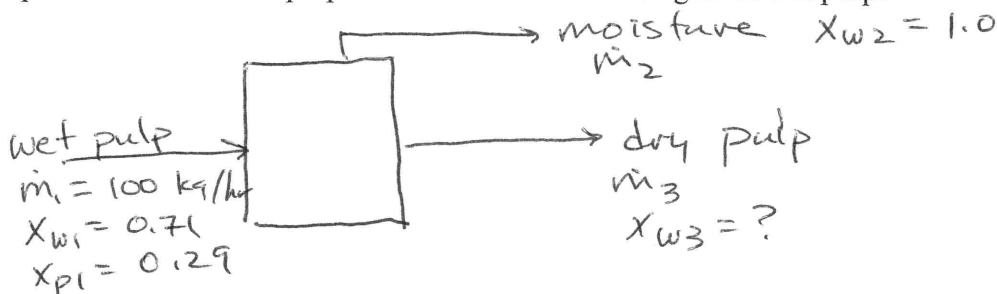


Example 1 Drying

A wet paper pulp contains 71 wt% water. After drying, it is found that 60 wt% of the original water has been removed. What is the composition of the dried pulp? Assume a basis of 100 kg/hr of wet pulp.

1. Draw Picture



2. DOF

$$\begin{array}{rcl}
 \text{Unknown} & = & \dot{m}_2, \dot{m}_3, X_{w3} = 3 \\
 \text{Balance equations} & = & 2 \\
 \text{Other equations} & = & 1 \\
 \hline
 \text{DOF} & = & 0
 \end{array}$$

(or \dot{m}_{w3} instead of X_{w3})

3. Write the 2 independent balances and the additional relationship

$$\dot{m}_1 = 1000 \text{ kg/hr} = \dot{m}_2 + \dot{m}_3$$

water balance $(0.71)\dot{m}_1 = \dot{m}_2 + X_{w3}\dot{m}_3$

other $\cancel{X_{w3}\dot{m}_3 = 0}, \quad \dot{m}_2 = (0.6)(0.71)(\dot{m}_1)$

4. Simplify $\dot{m}_2 = 42.6 \text{ kg/hr}$

$$\dot{m}_3 = 100 - 42.6 = 57.4 \text{ kg/hr}$$

water balance $71 = 42.6 - X_{w3}(57.4)$

$$X_{w3} = \frac{71 - 42.6}{57.4} = \boxed{0.495}$$

$$X_{p3} = 1 - 0.495 = \boxed{0.505}$$

$$X_{w,3} =$$

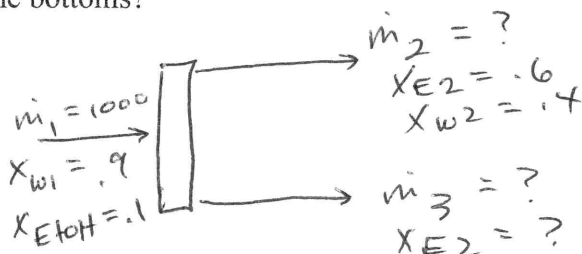
$$X_{p,3} =$$

Example 2

Distillation

A mixture containing 10 % EtOH and 90% H₂O by weight is fed to a distillation column at the rate of 1000 kg/h. The distillate contains 60 wt% EtOH. The distillate flow rate is 1/10th that of the feed. What is the composition and flow rate of the bottoms?

1. Draw Picture



$$\dot{m}_2 = \frac{1}{10} \dot{m}_1$$

2. DOF $\dot{m}_2, \dot{m}_3, X_{E2} = 3$

BE

OE

$$= 2$$

$$= 1$$

$$\text{DOF} = 0$$

3. Write balance equations and additional relationships

$$\dot{m}_1 = \dot{m}_2 + \dot{m}_3$$

$$\text{E balance } .1 \dot{m}_1 = .6 \dot{m}_2 + X_{E3} \dot{m}_3$$

$$\text{OE} \rightarrow \dot{m}_2 = \frac{1}{10} \dot{m}_1 = 100 \text{ kg/h}$$

4. Simplify $\dot{m}_3 = 1000 - 100 = 900 \text{ kg/h}$

$$\text{E balance } 100 = .6(100) + X_{E3}(900)$$

$$X_{E3} = \frac{100 - 60}{900} = 0.044$$

$$X_{w3} = 1 - 0.044 = 0.956$$

$$\dot{m}_{\text{bottoms}} =$$

$$X_{E, \text{bottoms}} =$$

$$X_{w, \text{bottoms}} =$$