

# Metodo Descomposicion

$$\lambda_{21} = -\frac{3}{15}$$

$$\lambda_{31} = -\frac{4}{15}$$

$$\lambda_{32} = -\frac{1.8}{17.4} = -\frac{3}{29}$$

El siguiente sistema de ecuaciones es utilizado para determinar concentraciones ( $C$ , en  $g/m^3$ ) en una serie de reactores acoplados, como función de la cantidad de masa ( $g/l/a$ ) que entra a cada uno de ellos.

$$A = \begin{bmatrix} 15 & -3 & -1 \\ -3 & 18 & -6 \\ -4 & -1 & 12 \end{bmatrix} \quad b = \begin{bmatrix} 3800 \\ 1900 \\ 2350 \end{bmatrix} \quad x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

$$\begin{aligned} 15C_1 - 3C_2 - C_3 &= 3800 \\ -3C_1 + 18C_2 - 6C_3 &= 1900 \\ -4C_1 - C_2 + 12C_3 &= 2350 \end{aligned}$$

$$\begin{aligned} F_2 - \lambda_{21}F_1 & \quad F_3 - \lambda_{31}F_1 & \quad F_3 - \lambda_{32}F_2 \\ \begin{bmatrix} 15 & -3 & -1 \\ -3 & 18 & -6 \\ -4 & -1 & 12 \end{bmatrix} & \rightarrow \begin{bmatrix} 15 & -3 & -1 \\ 0 & 17.4 & -6.2 \\ -4 & -1 & 12 \end{bmatrix} & \rightarrow \begin{bmatrix} 15 & -3 & -1 \\ 0 & 17.4 & -6.2 \\ 0 & -1.8 & 11.73 \end{bmatrix} \end{aligned}$$

$$\begin{aligned} -3 & 18 & -6 & -4 & -1 & 12 & 0 & -1.8 & 11.73 \\ -\frac{3}{15} \cdot 15 & -\frac{3}{15} \cdot (-3) & -\frac{3}{15} \cdot (-1) & -\frac{4}{15} \cdot 15 & -\frac{4}{15} \cdot (-3) & -\frac{4}{15} \cdot (-1) & -\frac{3}{29} \cdot 0 & -\frac{3}{29} \cdot (-1.8) & -\frac{3}{29} \cdot 11.73 \\ 0 & 17.4 & -6.2 & 0 & -1.8 & 11.73 & 0 & 0 & 11.09 \end{aligned}$$

$$U = \begin{bmatrix} 15 & -3 & -1 \\ 0 & 17.4 & -6.2 \\ 0 & 0 & 11.09 \end{bmatrix} \quad L = \begin{bmatrix} 1 & 0 & 0 \\ -\frac{3}{15} & 1 & 0 \\ -\frac{4}{15} & -\frac{3}{29} & 1 \end{bmatrix}$$

$$\begin{aligned} (1)(15) + (0)(0) + (0)(0) &= 15 & (1)(-3) + (0)(17.4) + (0)(0) &= -3 & (1)(-1) + (0)(-6.2) + (0)(11.09) &= -1 \\ \left(\frac{3}{15}\right)(15) + (1)(0) + (0)(0) &= -3 & \left(\frac{3}{15}\right)(-3) + (1)(17.4) + (0)(0) &= 18 & \left(\frac{3}{15}\right)(-1) + (1)(-6.2) + (0)(11.09) &= -6 \\ -\left(\frac{4}{15}\right)(15) + \left(-\frac{3}{29}\right)(0) + (1)(0) &= -4 & -\left(\frac{4}{15}\right)(-3) + \left(-\frac{3}{29}\right)(17.4) + (1)(0) &= -1 & -\left(\frac{4}{15}\right)(-1) + \left(-\frac{3}{29}\right)(-6.2) &+ (1)(11.09) \\ & & & & &= 11.98 \approx 12 \end{aligned}$$



$$y=b \begin{bmatrix} 1 & 0 & 0 \\ -3/15 & 1 & 0 \\ -4/15 & -3/24 & 1 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} 3800 \\ 1200 \\ 2350 \end{bmatrix} \quad \begin{aligned} y_1 &= 3800 \\ y_2 &= 1200 - (-3/15)y_1 \\ y_3 &= 2350 - (-4/15)(3800) - (-3/24)(1960) = 3566.01 \end{aligned}$$

$$y_3 = b_3 - \lambda_{31}y_1 - \lambda_{32}y_2 = 2350 - (-4/15)(3800) - (-3/24)(1960) = 3566.01$$

$$\begin{bmatrix} 15 & -3 & -1 \\ 0 & 17.4 & -6.2 \\ 0 & 0 & 11.09 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 3800 \\ 1960 \\ 3566.01 \end{bmatrix} \quad \begin{aligned} x_3 &= y_3 / u_{33} = \frac{3566.01}{11.09} = 321.55 \\ x_2 &= \frac{y_2 - u_{23}x_3}{u_{22}} \end{aligned}$$

$$x_2 = \frac{1960 - (-6.2)(321.55)}{17.4} = 227.20$$

$$x_1 = \frac{y_1 - u_{12}x_2 - u_{13}x_3}{u_{11}} = \frac{3800 - (-3)(227.20) - (-1)(321.55)}{15} = 320.21$$

• Cuanto se reducirá la concentración del reactor 3 si la tasa de masa de entrada a los reactores 1 y 2 se redujera en 500 y 200 g/día respectivamente.

$$15c_1 - 3c_2 - c_3 = 3300$$

$$-3c_1 + 18c_2 - 6c_3 = 1000$$

$$-4c_1 - c_2 + 12c_3 = 1650 \text{ o } 350$$

$$y=b \begin{bmatrix} 1 & 0 & 0 \\ -3/15 & 1 & 0 \\ -4/15 & -3/24 & 1 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} 3300 \\ 1000 \\ 2350 \end{bmatrix} \quad \begin{aligned} y_1 &= 3300 \\ y_2 &= 1000 - (-3/15)(3300) = 1660 \\ y_3 &= 2350 - (-4/15)(3300) - (-3/24)(1660) \\ y_3 &= 3401.72 \end{aligned}$$

$$\begin{bmatrix} 15 & -3 & -1 \\ 0 & 17.4 & -6.2 \\ 0 & 0 & 11.09 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 3300 \\ 1660 \\ 3401.72 \end{bmatrix} \quad x_3 = \frac{3401.72}{11.09} = 306.73$$

$$x_2 = \frac{1660 - (-6.2)(306.73)}{17.4} = 204.7 \quad \left. \begin{array}{l} \text{Reducción} \\ 321.55 - 306.73 = 14.82 \end{array} \right\}$$

$$x_1 = \frac{3300 - (-3)(204.7) - (-1)(306.73)}{15} = 281.38$$