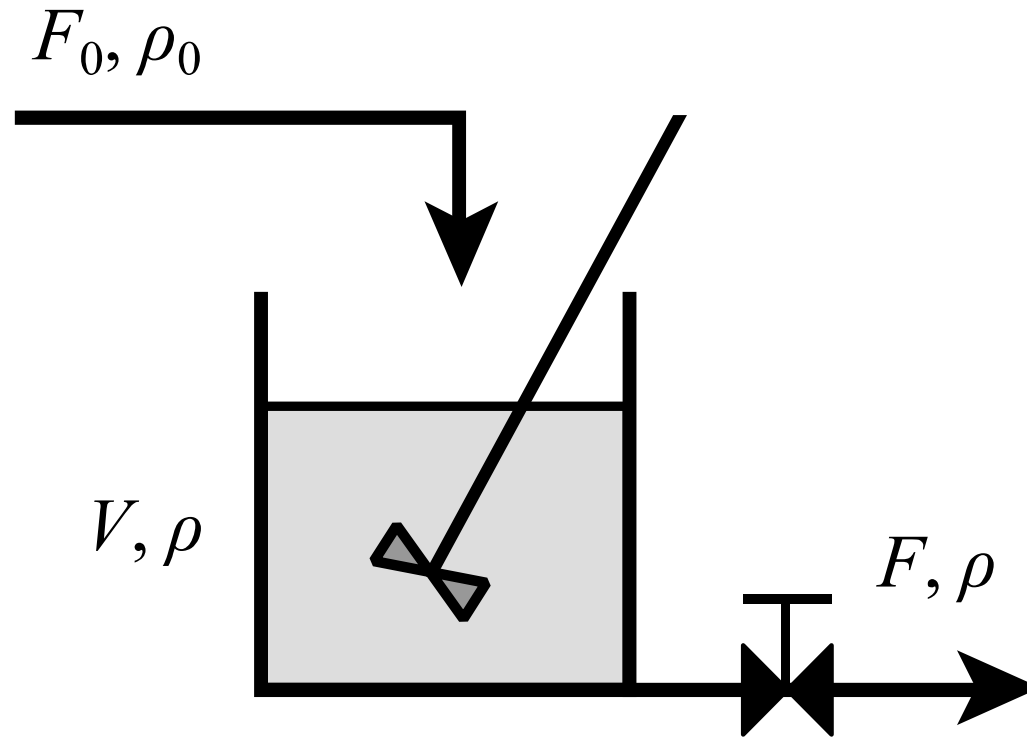


Modelado Parte VIII

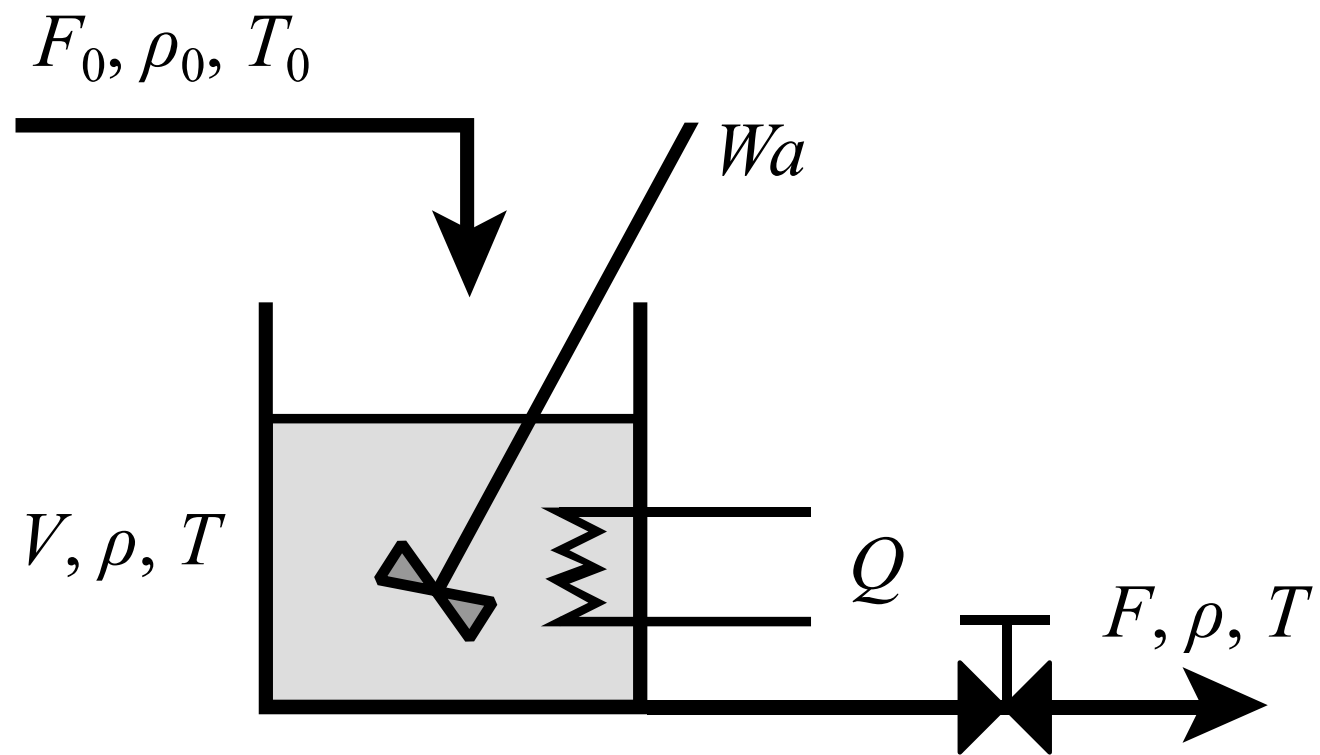
Enrique E. Tarifa, Facultad de Ingeniería, UNJu

Otros equipos

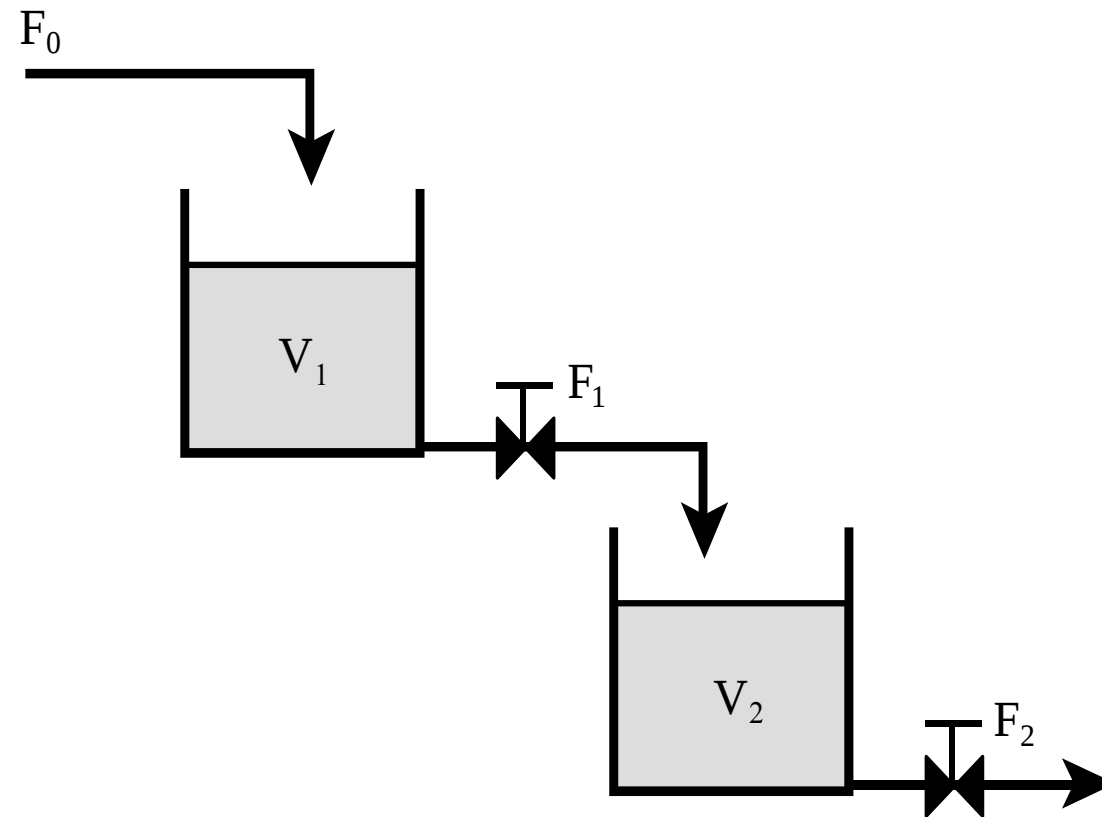
Tanque con descarga gravitatoria



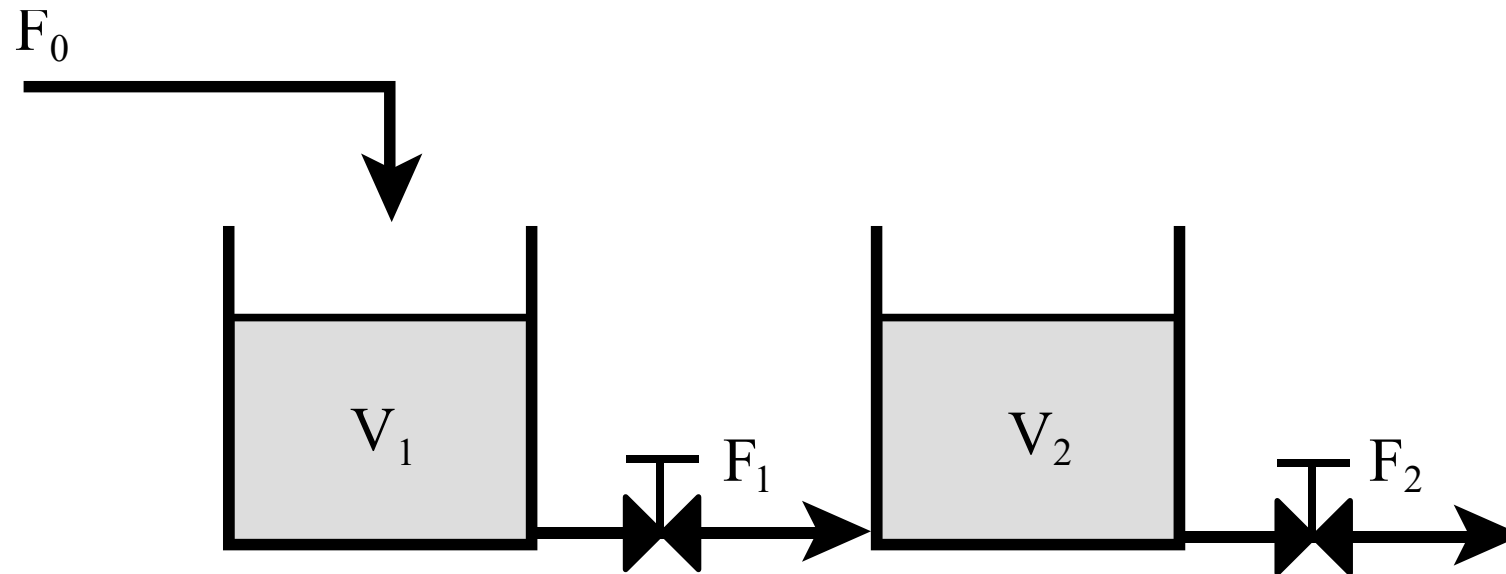
Tanque calefaccionado



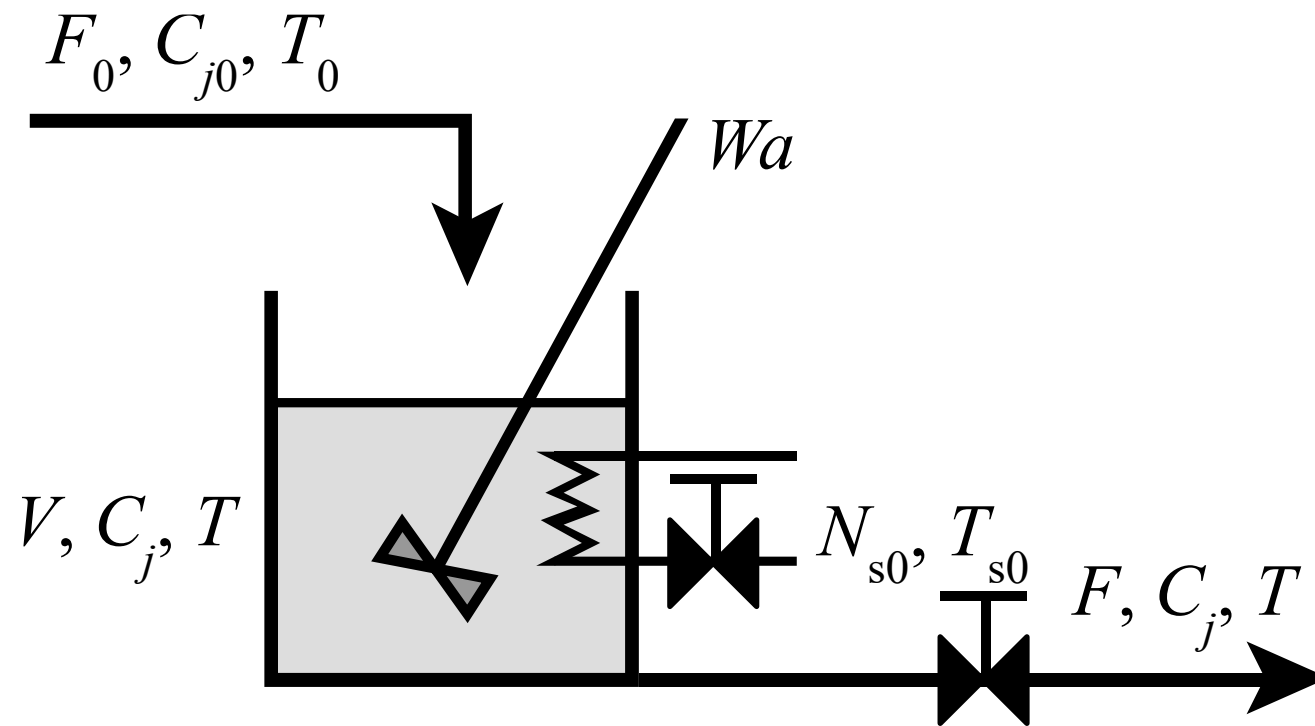
Tanques en serie no interactiva



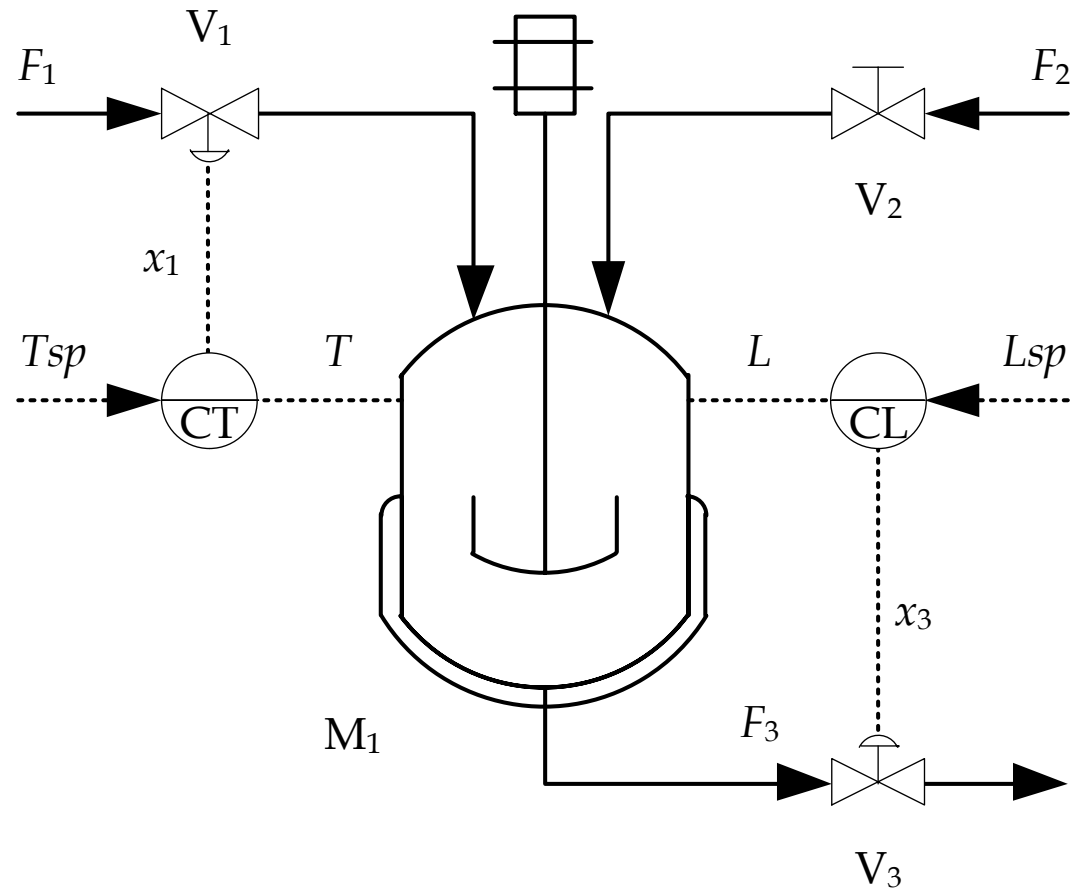
Tanques en serie interactiva



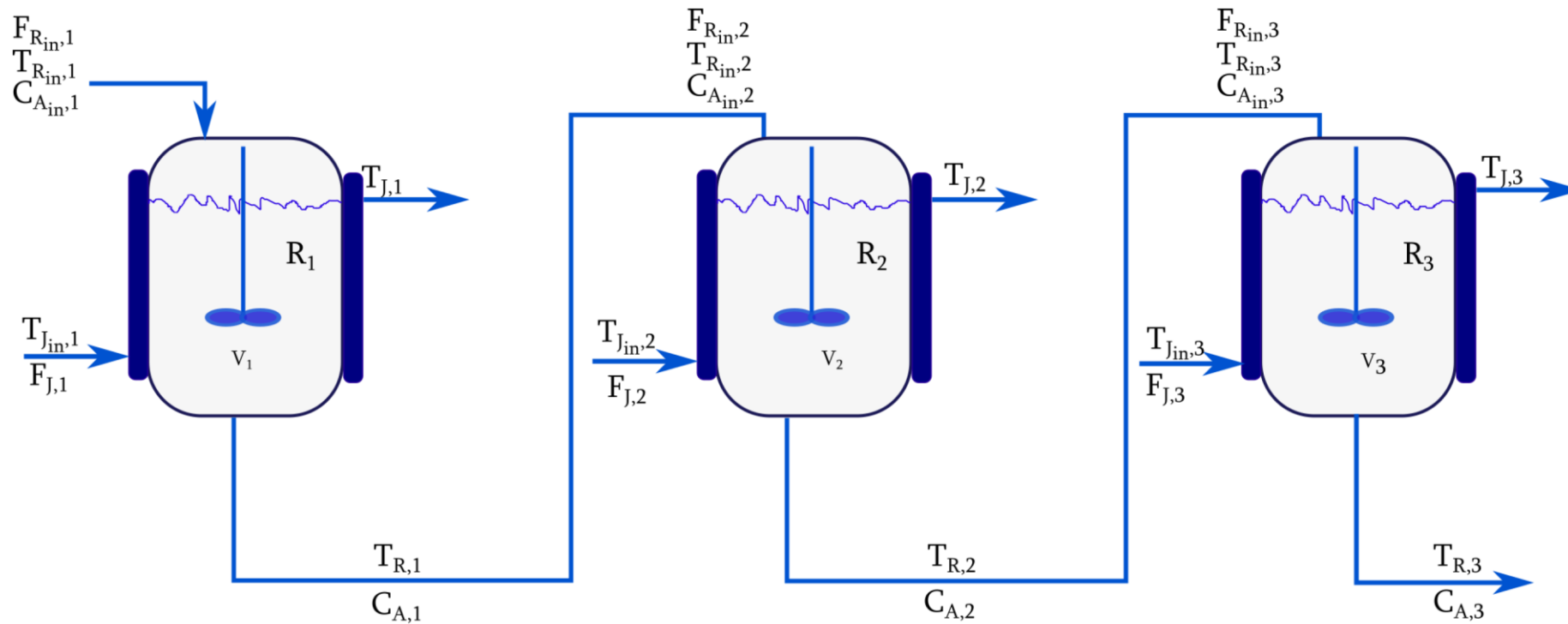
Reactor CSTR



Reactor con control

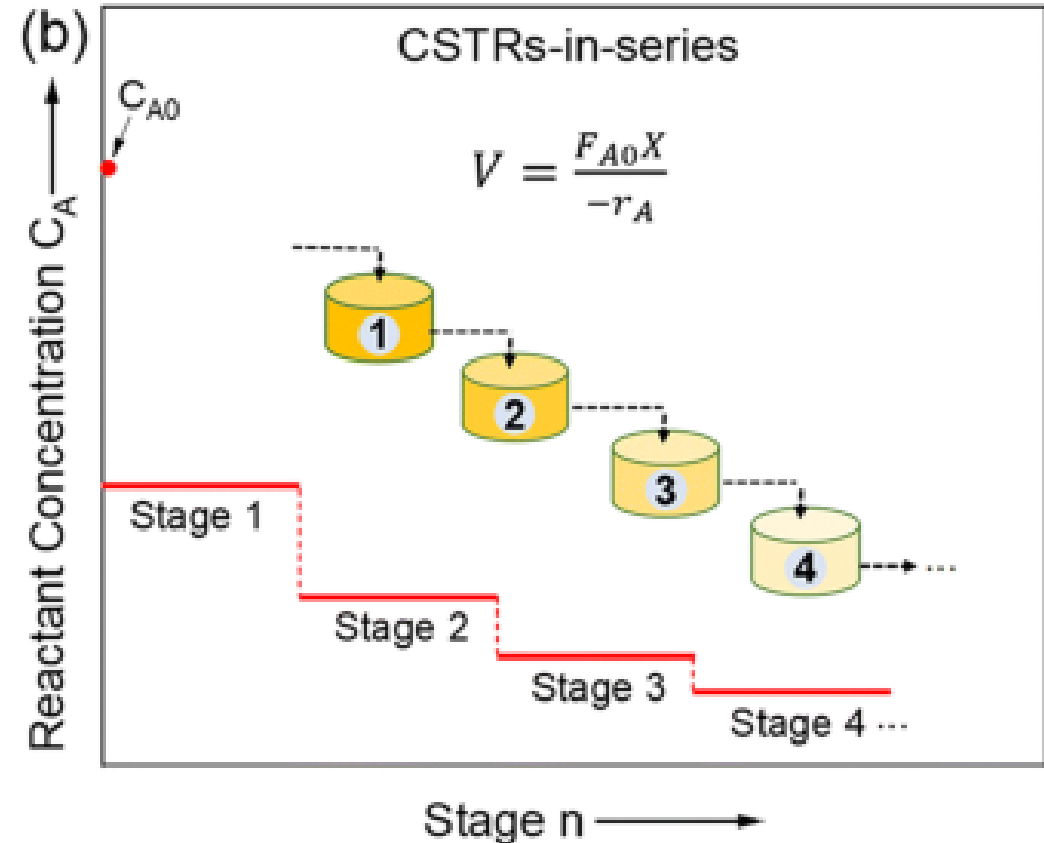
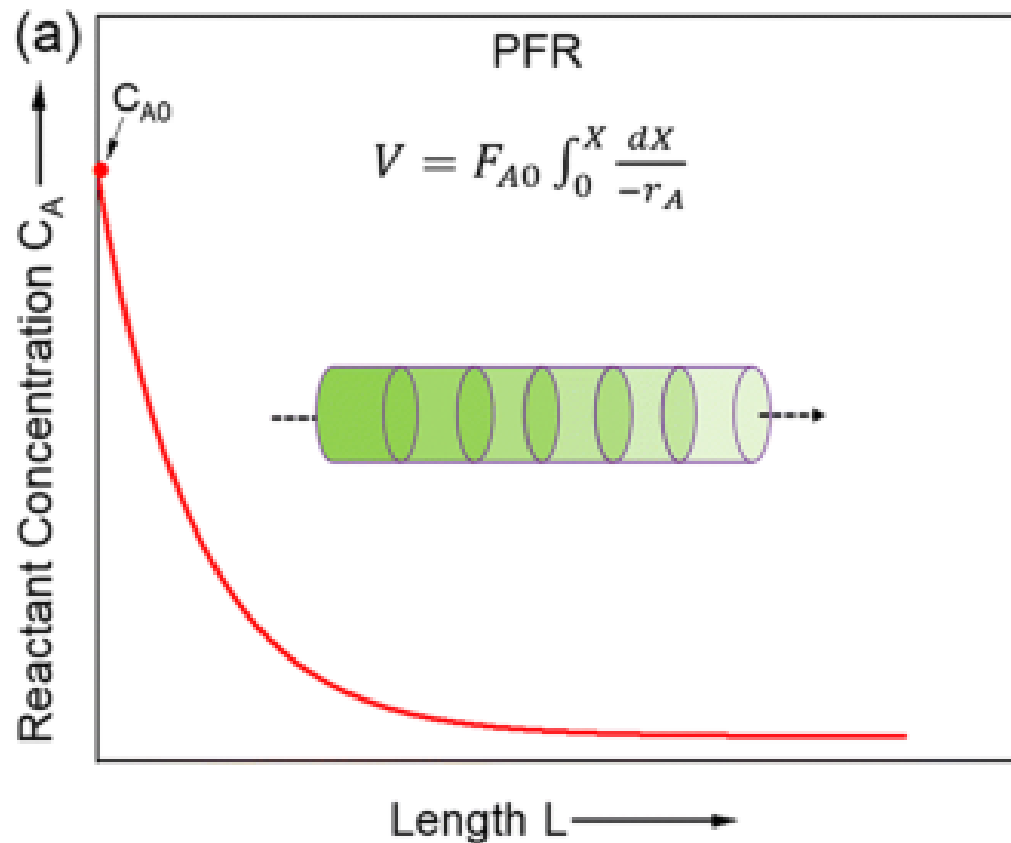


Tren de reactores

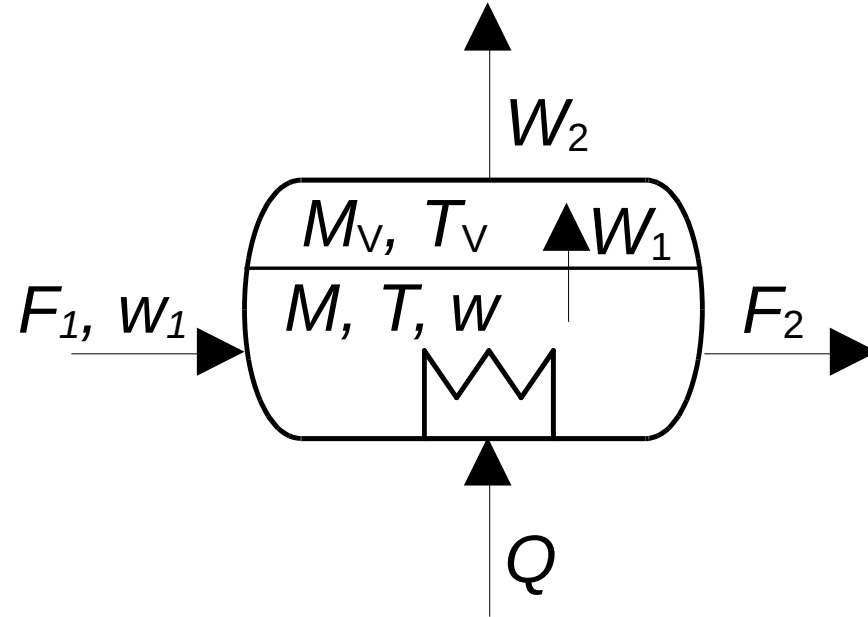


Del equipo i , salen las corrientes i .

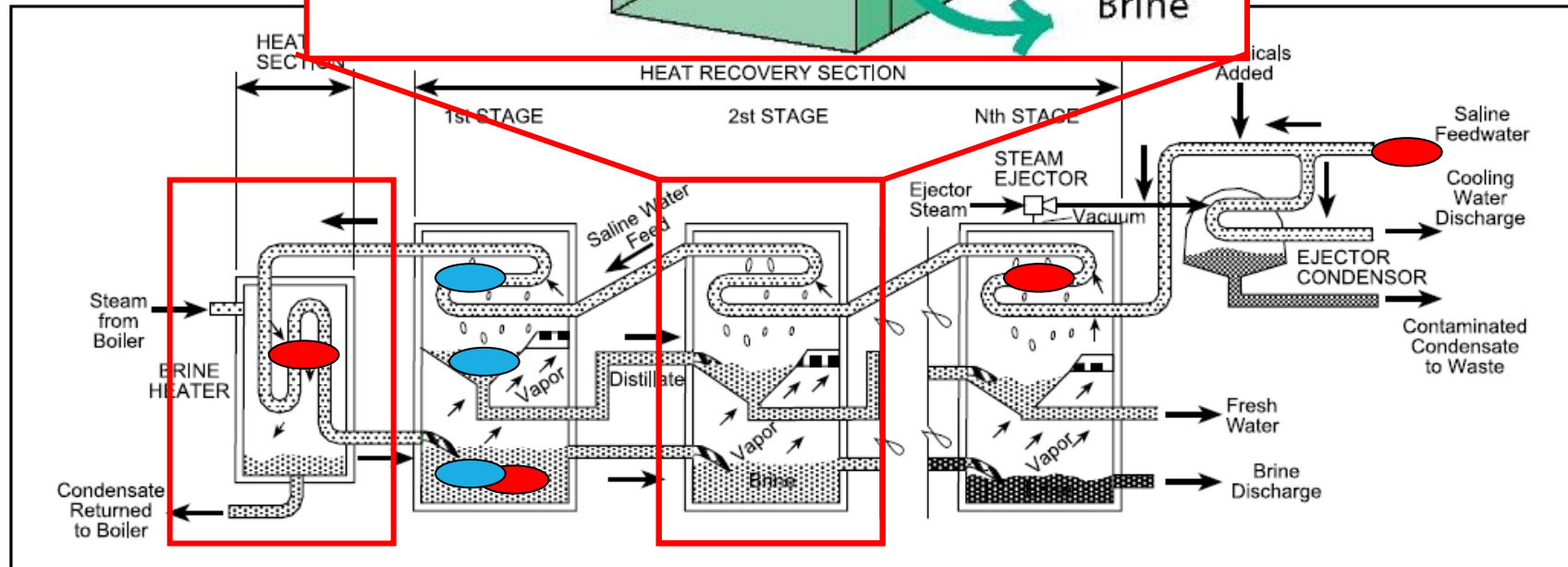
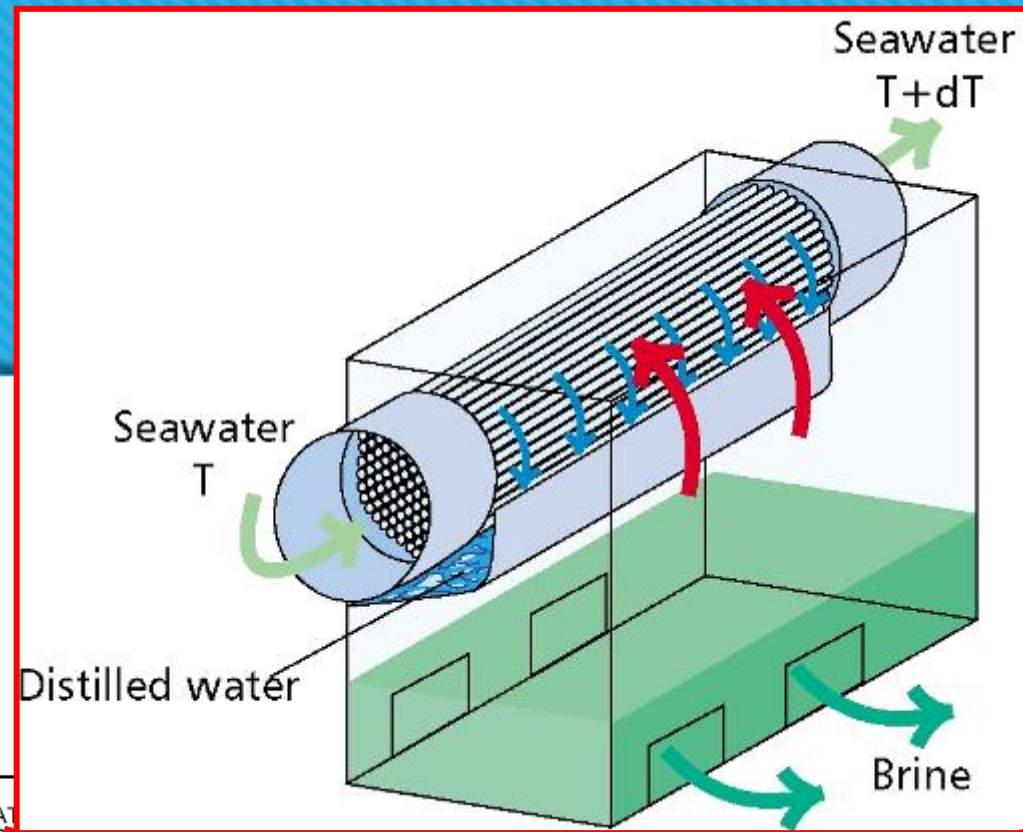
Reactor tubular



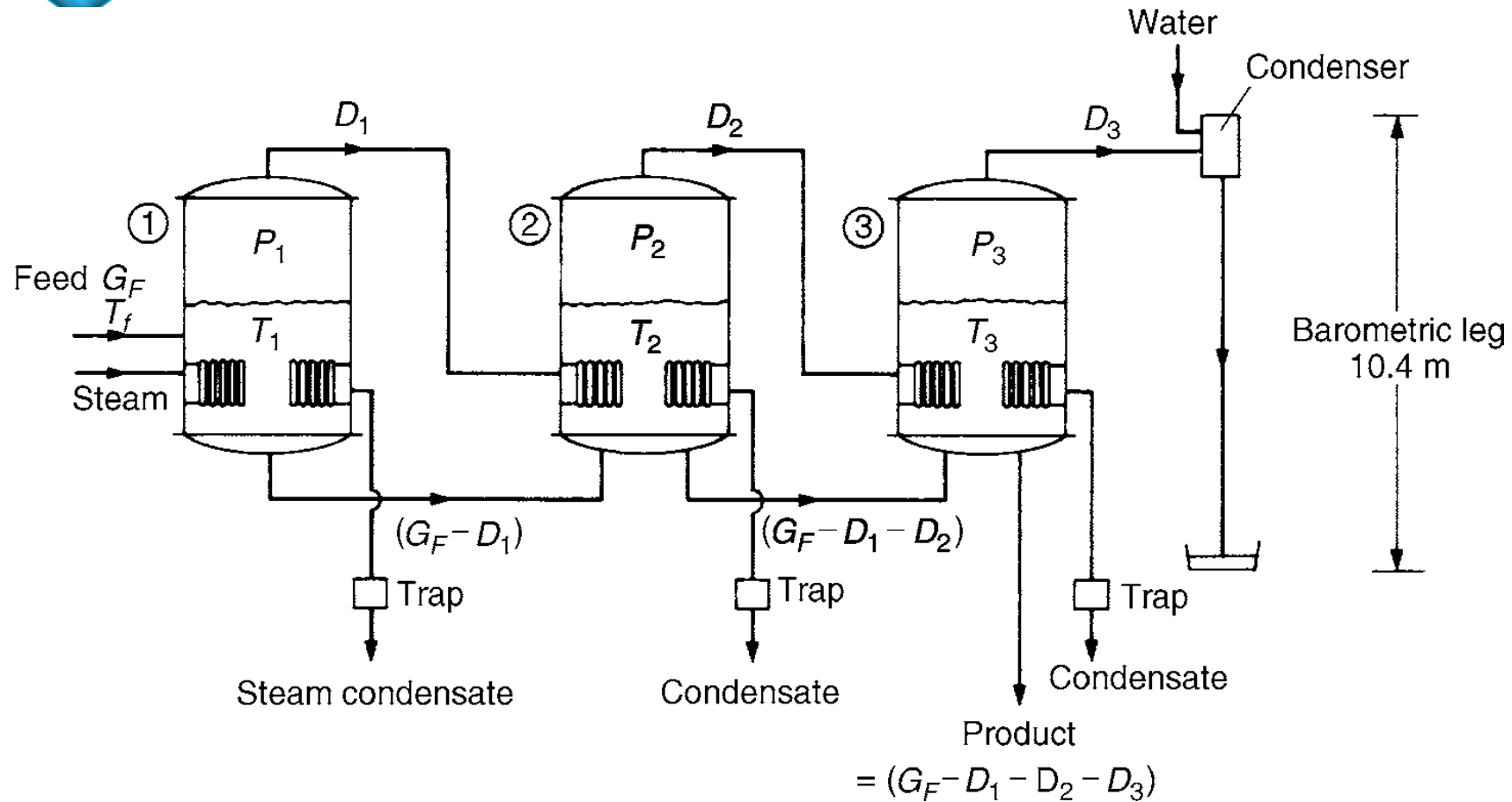
Evaporación



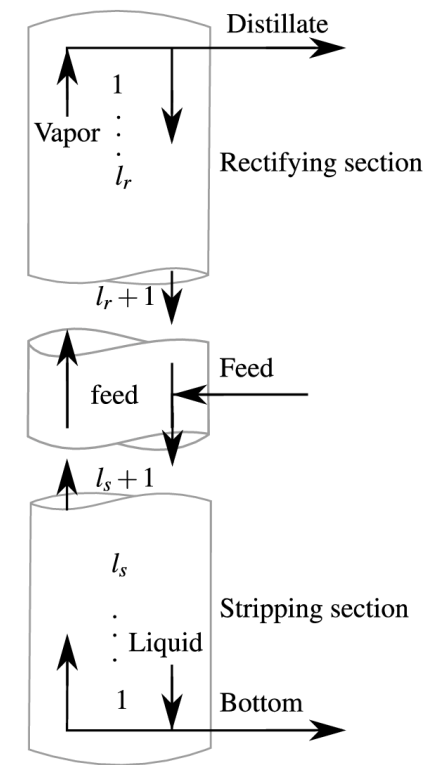
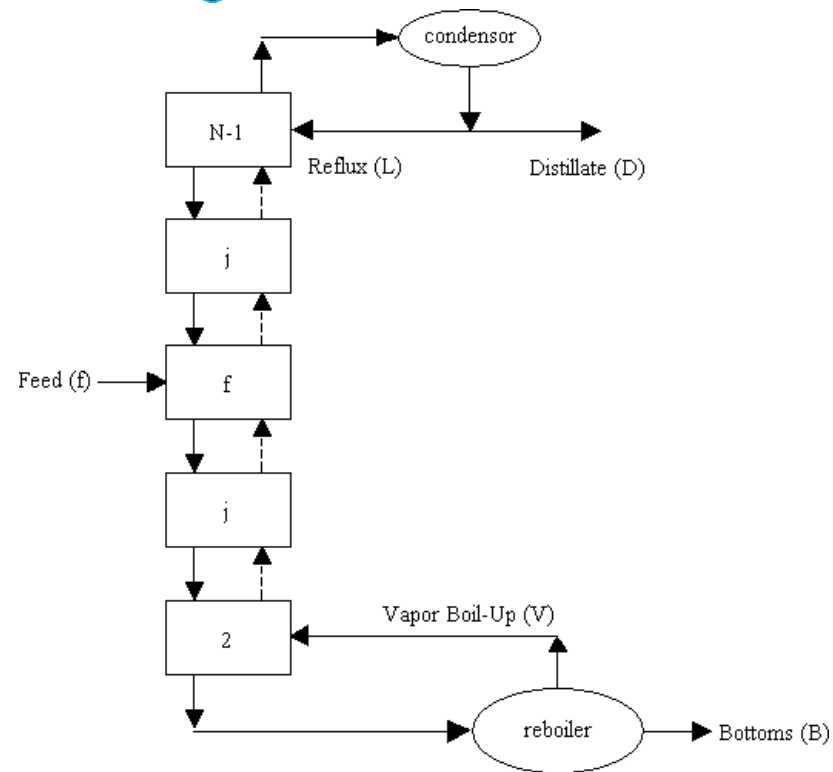
Desalador



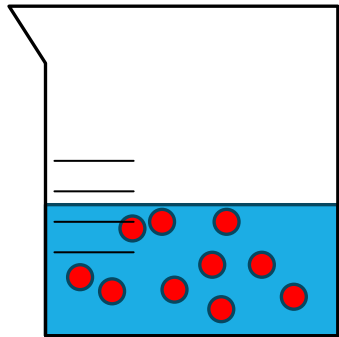
Evaporador de efecto múltiple



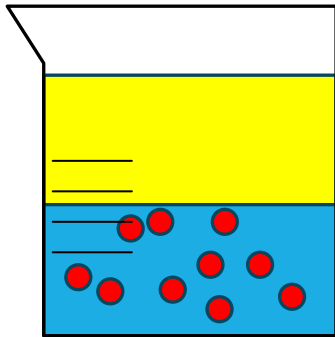
Columna de destilación



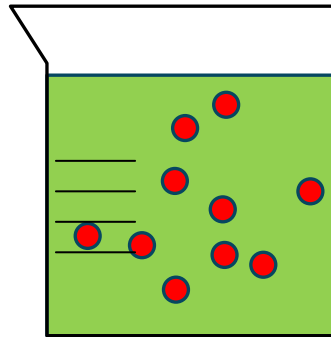
Extracción por solvente



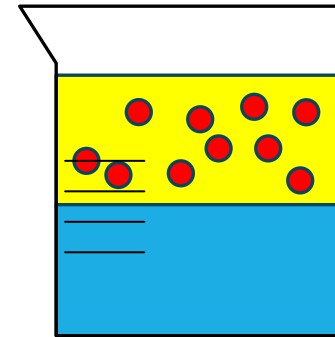
Solución original



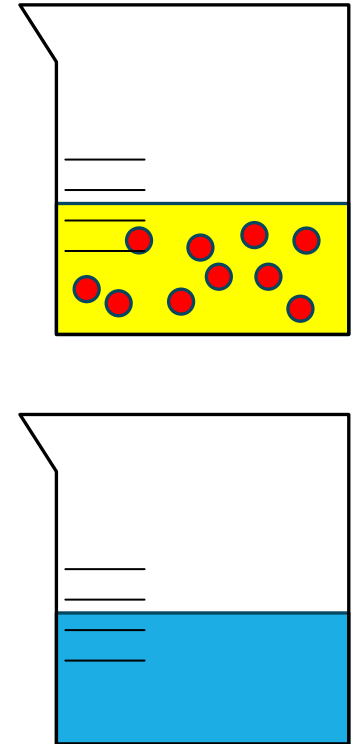
Agregado
de solvente



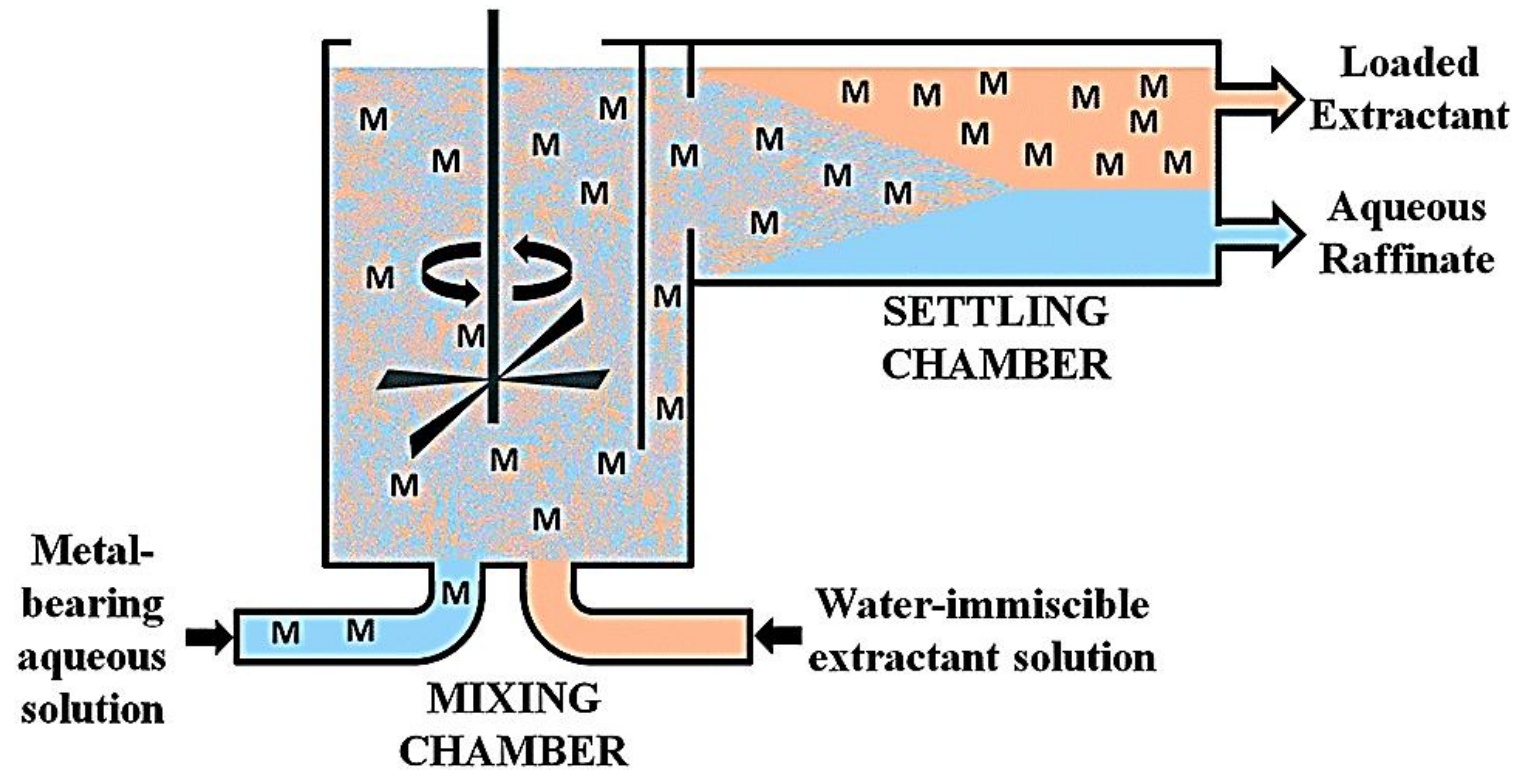
Mezclado



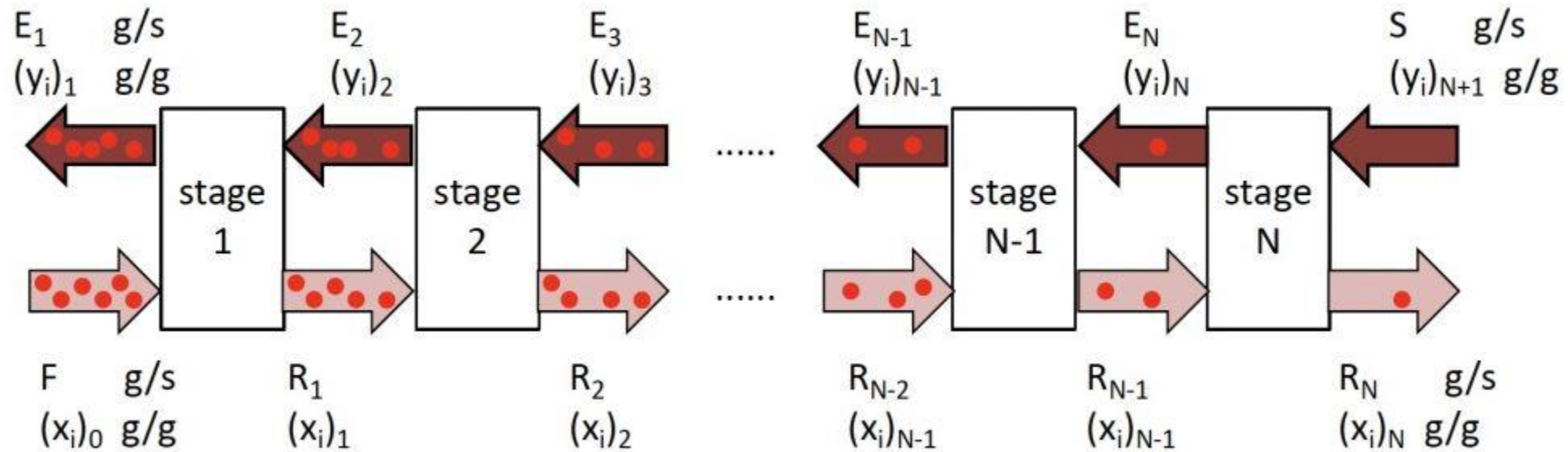
Decantación



Etapa de extracción por solvente

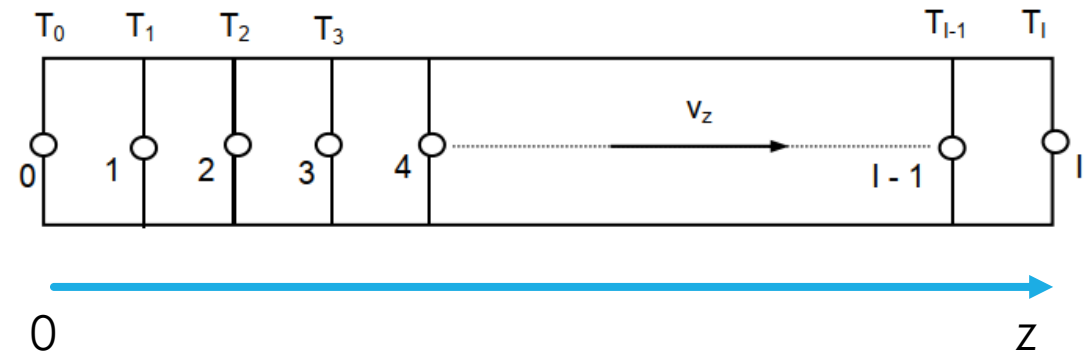


Extracción líquido-líquido contracorriente



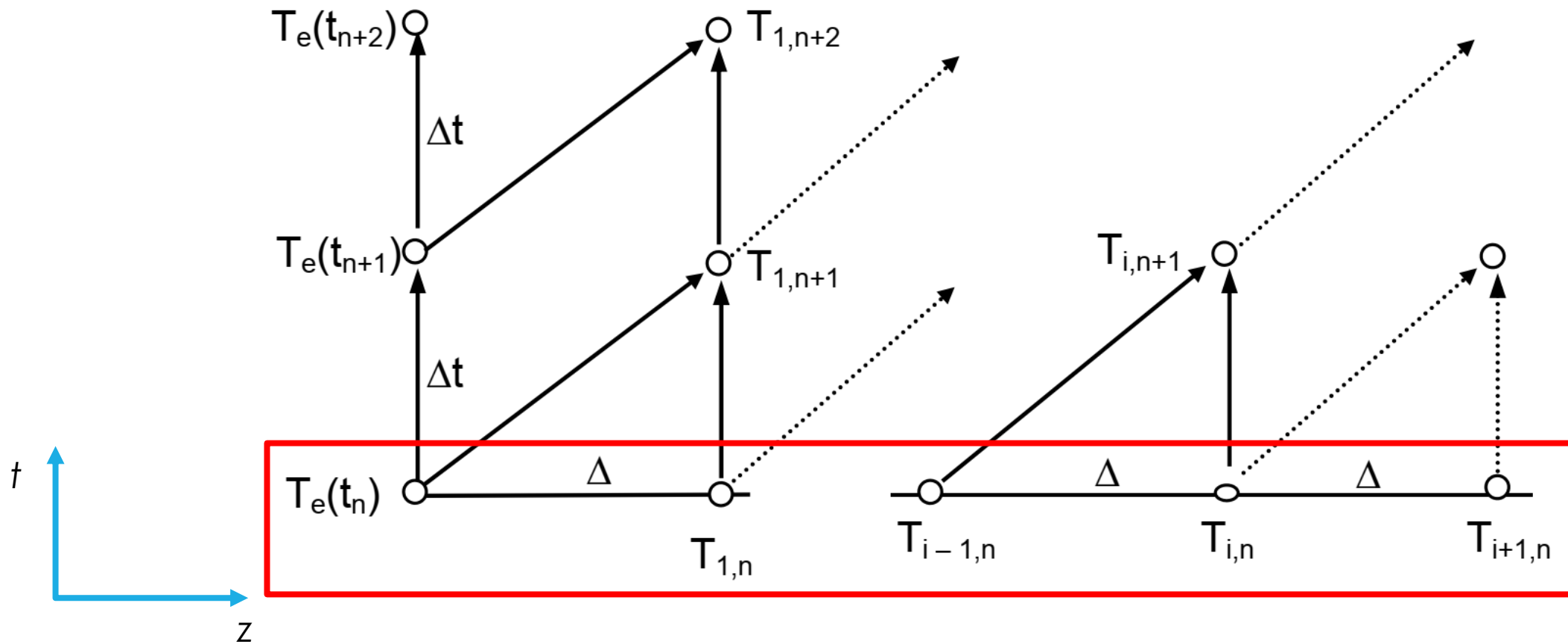
Reactor tubular

- Perfil inicial, en $t = 0$:
 - $C_A(z, 0) = C_{A0}(z)$
- Condición de contorno, $z = 0$:
 - $C_A(0, t) = C_{Ae}(t)$



$$\frac{\partial C_A}{\partial t} = -v \frac{\partial C_A}{\partial z} - k_A C_A$$

Discretización



Reactor tubular

PDEs

$$\frac{\partial C_A}{\partial t} = -v \frac{\partial C_A}{\partial z} - k_A C_A$$

Diferencias finitas

$$\frac{C_{i,n+1} - C_{i,n}}{\Delta t} = -v \frac{C_{i,n} - C_{i-1,n}}{\Delta z} - k_A C_{i,n}$$

adelante

atrás

Reactor tubular

Diferencias finitas

Solución

$$\frac{C_{i,n+1} - C_{i,n}}{\Delta t} = -v \frac{C_{i,n} - C_{i-1,n}}{\Delta z} - k_A C_{i,n}$$

$$C_{i,n+1} = \left(v \frac{\Delta t}{\Delta z} \right) C_{i-1,n} + \left(1 - \left(k_A + \frac{v}{\Delta z} \right) \Delta t \right) C_{i,n}$$

Reactor tubular

Condición de estabilidad

$$C_{i,n+1} = \left(v \frac{\Delta t}{\Delta z} \right) C_{i-1,n} + \underbrace{\left(1 - \left(k_A + \frac{v}{\Delta z} \right) \Delta t \right)}_{\geq 0} C_{i,n}$$

Paso máximo

$$\Delta t_{\max} = \frac{1}{k_A + \frac{v}{\Delta z}}$$

Caso de estudio

Reactor

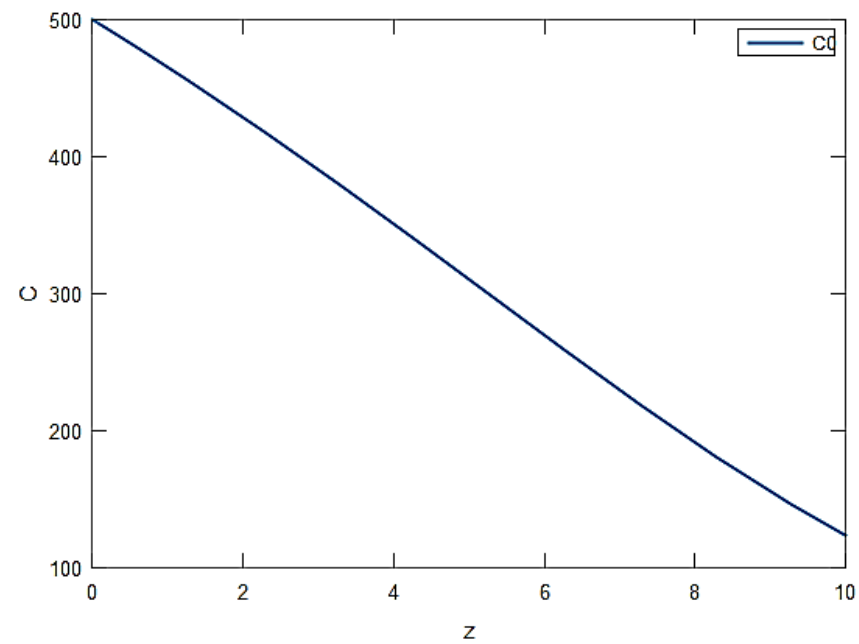
- Ejemplo 5.5, pg. 81, de *Análisis y Simulación de Procesos con Mathcad* (Gozálvez Zafrilla y Santafé Moros, 2015).
- Reactor tubular:
 - $L = 10 \text{ m}$
 - $D_{\text{int}} = 0.113 \text{ m}$

Estado

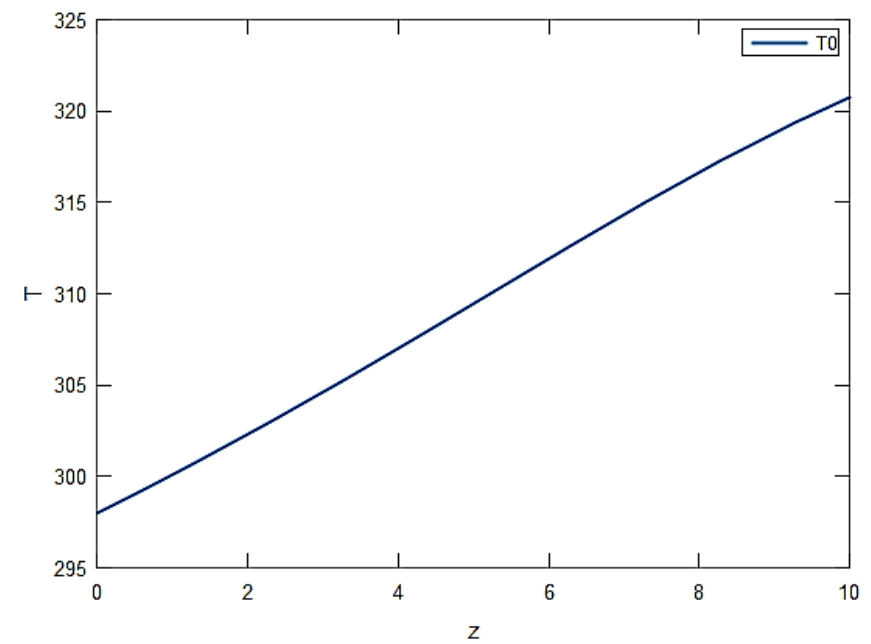
- Estado estacionario inicial:
 - $Q = 2\text{E-}3 \text{ m}^3/\text{s}$
 - $C_{\text{Ae1}} = 500 \text{ mol/m}^3$
 - $T_{\text{e1}} = 298 \text{ K}$
- Perturbación escalón:
 - $C_{\text{Ae}} = 1000 \text{ mol/m}^3$
 - $T_{\text{e2}} = T_{\text{e1}}$

GNU Octave

Perfil inicial de C

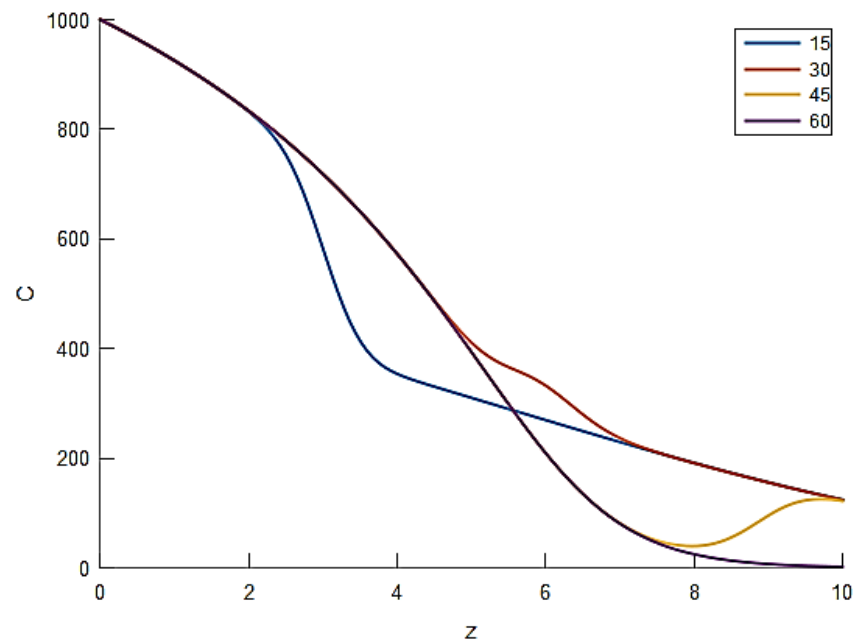


Perfil inicial de T

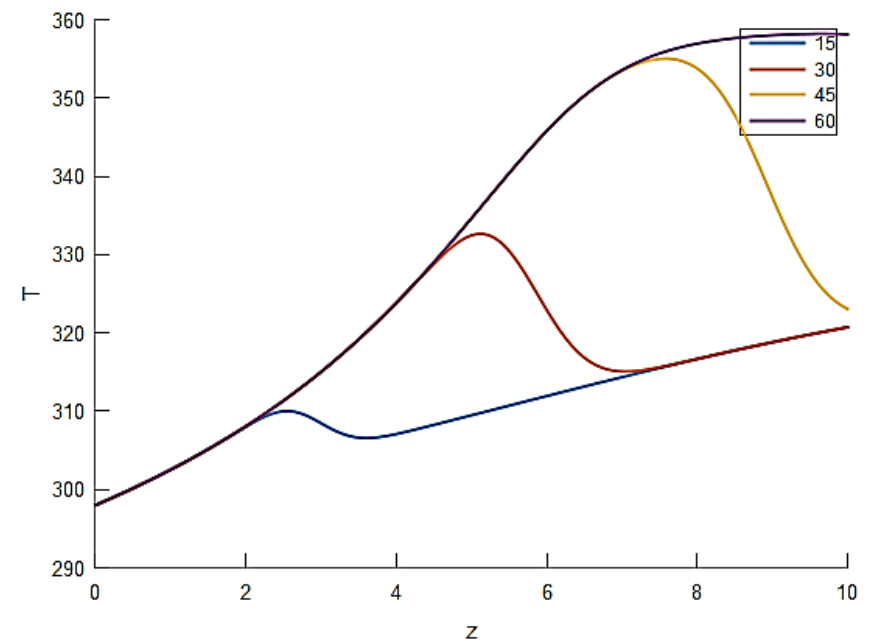


GNU Octave

C en el tiempo



T en el tiempo



reactor_tubular_Octave.m